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MONITORING APPROACHES FOR ASSESSING QUALITY OF HIGH ALTITUDE LAKES: COLORADO FLAT TOPS WILDERNESS AREA

by

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Results of a joint U.S. Environmental Protection Agency and U.S. Geological Survey sampling effort conducted during 1982 and 1983 on three lakes in the Flat Tops Wilderness Area of Colorado are summarized. Ned Wilson, Oyster and Upper Island Lakes were surveyed. They are representative of the range of sensitive lakes in the area threatened by acid deposition. Biological and chemical lake characteristics are assessed to determine efficient monitoring approaches for the three index lakes and similar lakes of the area.

Biological communities and water quality of the three study lakes in the Flat Tops Wilderness area are susceptible to effects of acid desposition. Early effects of acidification will best be observed by changes in water quality, biotic communities and occasionally indicator species.

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ABSTRACT

Three high altitude lakes were sampled to investigate their acidification potential and to develop monitoring approaches for assessing lake sensitivity to acid deposition. Sampling of Ned Wilson, Oyster and Upper Island lakes in the Flat Top Wilderness Area of Colorado was conducted in 1982 and 1983. These lakes are representative of the range of lakes sensitive to acid deposition in the area.

Data collected show the three study lakes are biologically and chemically similar. Available literature suggests biological communities of the study lakes are sensitive to acidification, with major impacts expected as pH drops below 5.5. Lack of acidity sensitivity data for most species of organisms inhabiting the study lakes precludes concise predictions of biological response to acidification. However, annual sampling for community changes and indicator species of photoplankton, zooplankton and macrophyte populations is recommended. Data on fish population structure and maintenance mechanisms are needed before fish community information can be used for monitoring, but metal concentration data for fish tissue and sediments should be collected for residue levels. A suite of nineteen physical and chemical water quality parameters, including eight metals, is recommended for annual scans.

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INTRODUCTION

The Environmental Monitoring Systems Laboratory-Las Vegas, Nevada (EMSL-LV) assisted the Agency's Region 8, Environmental Services Division, in a joint EPA and U.S. Geological Survey (USGS) investigation of the acidification potential of selected lakes in the Flat Tops Wilderness Area of Colorado. A second objective was to assist in developing a monitoring program suitable for application to regional high altitude lakes. The results of sampling conducted during 1982 and 1983 on three Flat Tops index lakes are reported here together with an evaluation of monitoring methods which could be applied to long term monitoring programs for assessing lake acidification.

The Flat Tops Wilderness Area is located in the White River National Forest of northwestern Colorado. This unique recreation resource contains numerous lakes, many higher than 3300 m in elevation, accessible to the public only by foot or horseback. Nevertheless, the area receives considerable use by hikers, campers, and fisherman during the summer. Brook trout (*Salvelinus fontinalis*), rainbow trout (*Salmo gairdneri*), cutthroat trout (*Salmo clarki*) and cutthroatrainbow trout hybrids are present in many lakes. Additionally, some fishless lakes in the region contain dense populations of tiger salamanders, *Ambystoma tigrinum*. Wilderness designation requires the U.S. Forest Service to protect the Flat Tops from unacceptable adverse impact as identified by the Clean Air Act amendments of 1977.

Approximately 370 lakes within the Flat Tops Wilderness Area are considered to be very sensitive to acidification (Turk and Adams 1983). All have alkalinities, either predicted or measured, less than or equal to 200 µeq/l CaCO$_3$; some as low as 70 µeq/l CaCO$_3$ (Turk and Adams 1983). The high sensitivity of these lakes results principally from the small amounts of calcarious sediments in their watershed because of the basalt caprock underlying the high altitude lake beds and watersheds (USDA, Forest Service 1981). Additionally, small watershed-to-lake surface area ratios reduce the water/soil contact time, hence dissolved CaCO$_3$, during runoff.

NO$_x$ and SO$_2$ contaminated wet fallout has been reported to produce low levels of acid precipitation on the western slope of the Colorado Rocky Mountains (Lewis and Grant 1980). The pH of rain equilibrated with atmospheric CO$_2$ should average near 5.6 or slightly greater (McColl 1980). However, the average pH of summer and winter precipitation events between the summers of 1980 and 1983 were 4.61 and 4.79 near Gothic, Colorado, 100 km south of the Flat Tops (Harte et al. 1984). Precipitation with pH values of 3.6 has been recorded near Boulder, Colorado (Lewis and Grant 1980).

The severity of acid precipitation impacts in the Flat Tops could increase due to expansion of the oil shale industry. Expansion of synfuels (including oil shale) production and coal-fired power plants on the Rocky Mountain western slope "Energy Belt" may increase hydrogen ion concentrations in wet and dry deposition. Releases of SO_2 and NO_x from a single 1-million-barrel-per-day oil shale retort were conservatively estimated at 1,800 ton/yr and 30,000 ton/yr, respectively (U.S. Department of Interior 1973). Oil shale developmental activities in western Colorado and eastern Utah have declined in number and rate during recent years. When large scale commercial development resumes, shale retorts, oil refineries, power plants, transportation and population gains will undoubtedly contribute increasing amounts of SO_2 and NO_x to the atmosphere. Additionally, because the prevailing winds are westerly in western Colorado and eastern Utah (V.T.N. Colorado Inc. 1979), the first significant contiguous mountain range that air masses from the oil shale industry areas would encounter is the Flat Tops. As a result, a major portion of moisture and projected pollutants within these masses could be deposited upon the wilderness area.

Historical information on characteristics of lakes within the Coloarado Rockies, such as those of the Flat Tops Wilderness Area, is limited (Lewis 1982). Chemical and biological inventories of selected index lakes within the Flat Tops have been initiated by the U.S. EPA, Forest Service and USGS to generate baseline information. These surveys are being conducted to provide historical data which will help both to quantify expected ecological disturbances associated with lake acidification (temporal changes) and to develop a monitoring program. The lack of historical biological and chemical baseline data in acidified lakes of the northeastern U.S. and Europe has hindered attempts to demonstrate quantitative changes over time. Ecological damage, for the most part, has been assessed by comparing acidified and non-acidified lakes with similar morphological features and watershed characteristics.

Unique sampling problems are encountered in wilderness areas. Because the Flat Tops are normally accessible only by foot or horseback, severe restrictions are placed on the use of the cumbersome and/or fragile equipment used in more conventional studies. Additionally, sampling is restricted to summer (ice free) months due to a heavy snowpack most of the year. It is hoped that monitoring approaches and techniques tested in the lakes of the Flat Tops will help identify techniques best suited for these conditions. Attempts have been made to incorporate recommendations of the Aquatic Effects Task Group, (Bricker et al. 1983) in terms of chemical parameters identified for inclusion in the National Sampling and Analysis Protocol for Chemical Characteristics of Lakes and Streams Sensitive to Acidic Deposition. However, because the work reported here focuses on regional lakes with unique characteristics and monitoring requirements, some deviations from, and expansion of, the national protocol are necessary. A national biological protocol is available only in draft stage at this writing (Cornell University, 1983). This draft protocol was also consulted in development of a high altitude lakes monitoring program, and key elements have been incorporated.

The data presented in this report provide a basis to substantiate future acid impacts and their severity. Future monitoring of the three Flat Tops lakes may provide early warning of disruptions to lake ecosystems of the region.

STUDY AREA

The Flat Tops Wilderness Area is located in northwestern Colorado on the White River Plateau, north of Glenwood Springs and east of Meeker (Figure 1). The basaltic cap overlying the limestone and dolomite formation has been dissected in places by streams and glacial action, exposing the softer materials to erosive forces. Erosion of these softer materials has caused the numerous steep canyons common to the area.

Much of the White River Plateau is at an elevation of nearly 3350 m, with occasional peaks reaching about 3650 m. Annual precipitation in the area averages over 76 cm, with over two-thirds occurring as snowfall. Snowpack melt during the summer contributes much of the flow to the White River which has its headwaters in the Flat Tops. Specific geochemical information is available from Turk and Adams (1983).

The three lakes selected as index lakes are Ned Wilson, Oyster, and Upper Island. These represent a gradient of susceptible lakes found in the Flat Tops. Summary data on watershed characteristics of the three lakes are presented in Table 1.

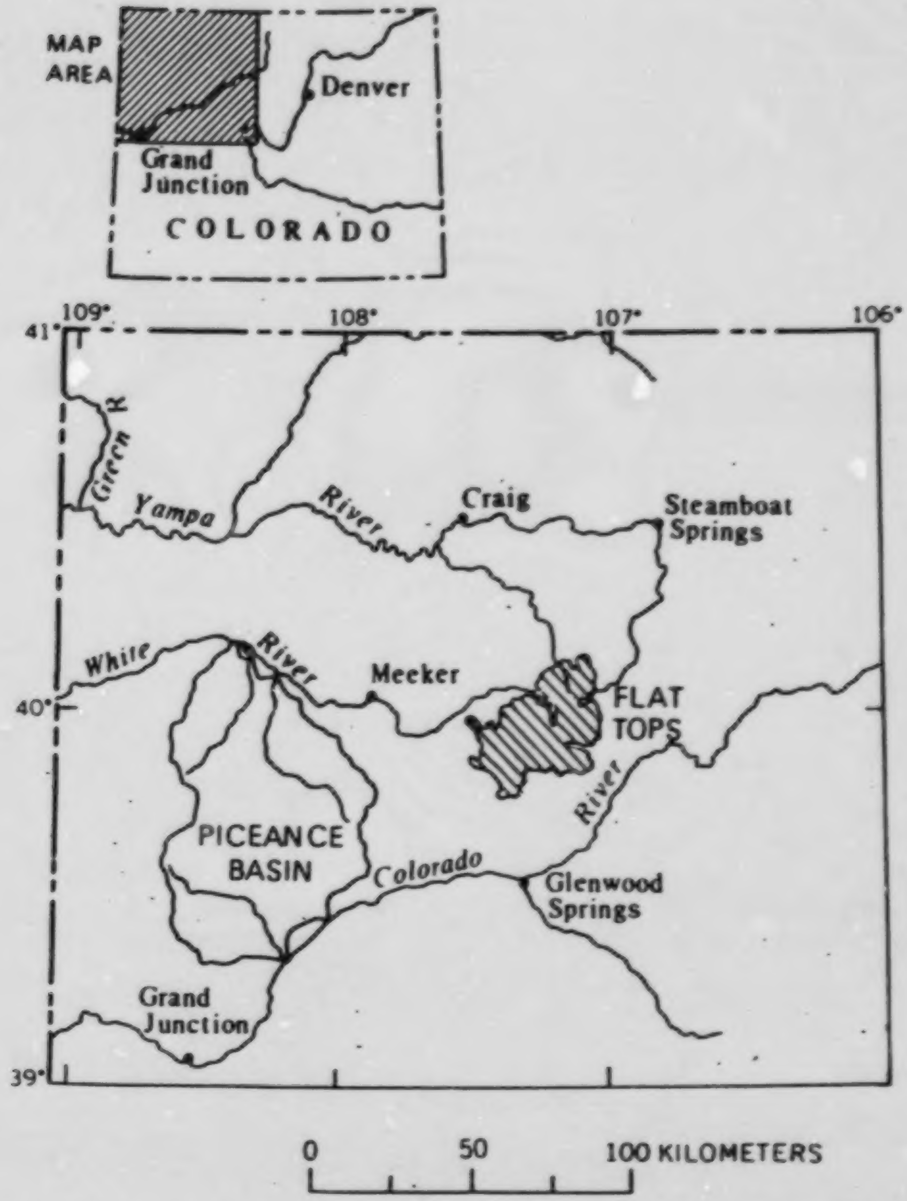
MAP
AREA
Denver
Grand Junction
COLORADO
109°
108°
107°
106°
41°
40°
39°
Green R
Yampa
River
Craig
Steamboat Springs
White
River
Meeker
FLAT TOPS
PICEANCE BASIN
Colorado
River
Glenwood Springs
Grand Junction
0
50
100 KILOMETERS

Figure 1. Map showing location of Flat Tops Wilderness Area in Colorado (from Turk and Adams 1983 with permission).

TABLE 1. WATERSHED CHARACTERISTICS AND ALKALINITY OF THE THREE FLAT TOPS WILDERNESS AREA STUDY LAKES (From Turk and Adams 1983).

PARAMETER	NED WILSON	OYSTER	UPPER ISLAND
Latitude	39°57'43"	39°55'18"	39°55'35"
Longitude	107°19'25"	107°24'26"	107°10'06"
Elevation (m)	3388	3241	3413
Exposed Bedrock (%)	0	100	100
Surface Area (ha)	1.0	6.4	7.9
Mean Depth (m)	3.7	2.0[1]	6.4
Max. Depth (m) approx.	5.3	3.0	15.8
Drainage Area (ha)	50	130	90
Alkalinity (μeq/l)	70	200	100

Note[1] - Estimated

SAMPLE LOCATIONS AND DATES

Ned Wilson Lake

The smallest lake sampled, Ned Wilson Lake (Figure 2), contained four limnetic sites from which zooplankton, phytoplankton, benthic macroinvertebrates, (quantitative) physical chemical profiles, sediments and water chemistry samples were obtained. Ned Wilson site 1 (NW1) was located in the center of the mouth of the south cove, east of the rock cliffs; maximum depth was approximately 4.3 m. Ned Wilson site 2 (NW2) was located in the lake's center. Maximum depth was approximately 5.3 m. Ned Wilson site 3 (NW3) was located at the center of the mouth of the north cove equidistant to rock points on the east and northwest shore; maximum depth was approximately 2.5 m. Ned Wilson site 4 (NW4) was located approximately 100 m lakeward from the shoreline of the shallow cove at the west end of the lake, west side of rock cliffs; maximum depth was approximately 5.0 m. Periphyton and special invertebrate sample sites are identified in Figure 2.

Oyster Lake

Oyster Lake did not contain rock substrates, hence no rock or periphyton samples were collected. Oyster Lake (Figure 3) site 1 (OL1) was located about one-third distance from the west end, approximately equidistant from three shores. Maximum depth was approximately 3 m. Oyster Lake site (2) (OL2) was located about one/third the distance from the east end, nearly equidistant from all shores of the east cove; maximum depth was 2.5 m.

Upper Island Lake

Upper Island (Figure 4), the largest lake sampled, contained only one site with soft substrate; macroinvertebrate Ekman samples were collected only at this site. Upper Island site 1 (UI1) was located in the western end of the lake, equidistant from three shores; maximum depth was 3.5 m. During 1982, UI1 was located within a small cove, which during 1983 was separated from the main lake. Upper Island site 2 (UI2) was erroneously located in 1983 midway between the island and the south shore near the inlet; maximum depth was approximately 4.5 m. In 1982, UI2 was located midway between the island and the point on the northwest shore. Upper Island site 3 (UI3) was located midway between the island and the rock point on the southwest shore; maximum depth was approximately 7.3 m. Upper Island site 4 (UI4) was located in the eastern basin, midway between the island and the east shore; maximum depth was approximately 15.8 m.

Each of the three lakes was sampled during the latter half of August in 1982 and 1983. All 1982 samples were collected from Ned Wilson, Oyster, and

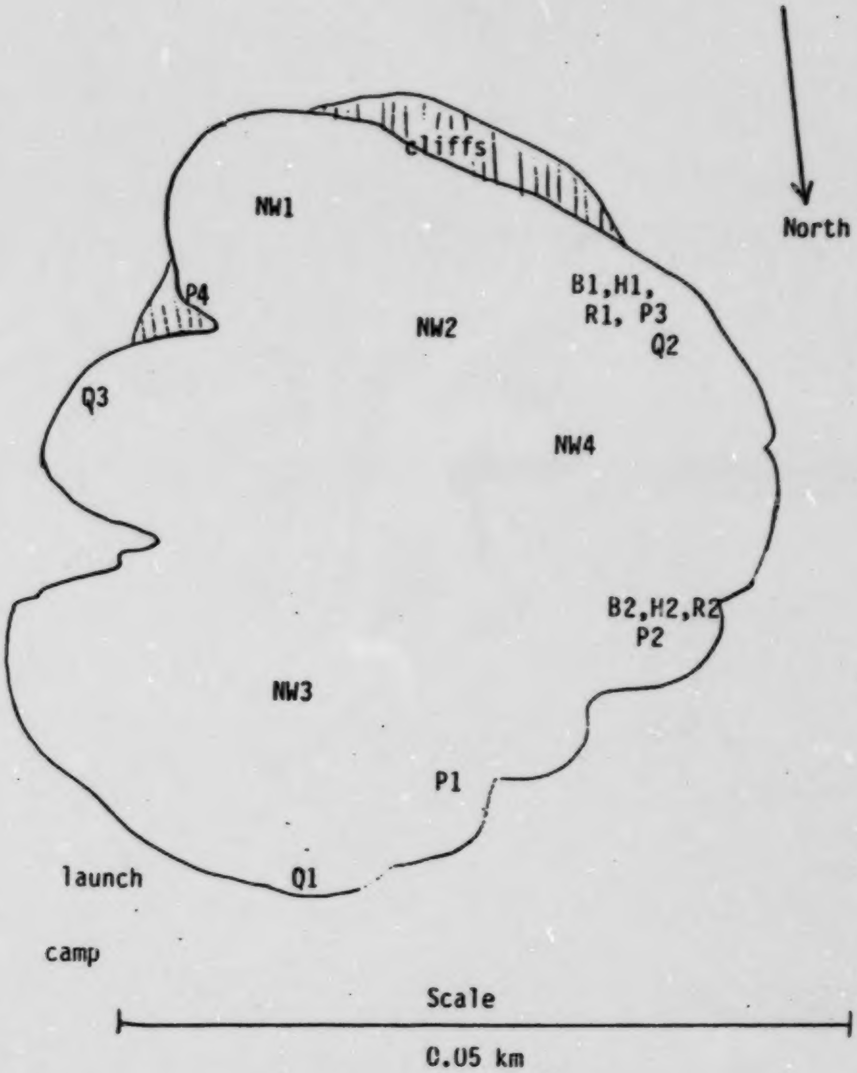
North
cliffs
NW1
NW2
NW3
NW4
P4
Q3
B1,H1,
R1, P3
Q2
B2,H2,R2
P2
P1
Q1
launch
camp
Scale
0.05 km

Figure 2. Sketch of Ned Wilson Lake and sites sampled during August 1982 and August 1983. Qualitative (dip net) invertebrate sites are noted by Q#s, quantitative invertebrates (Ekman), phytoplankton, zooplankton, sediment and water quality sites are noted by NW#s, periphyton sites by P#s, Hester-Dendy sites by H#s, basket sites by B#s and 10-rock sits by R#s.

Upper Island Lakes on August 17, 18, and 20, respectively, except where otherwise noted. During 1982, the three lakes were sampled during August 25 and 26, 23 and 24, and 27 and 28, respectively, unless otherwise noted.

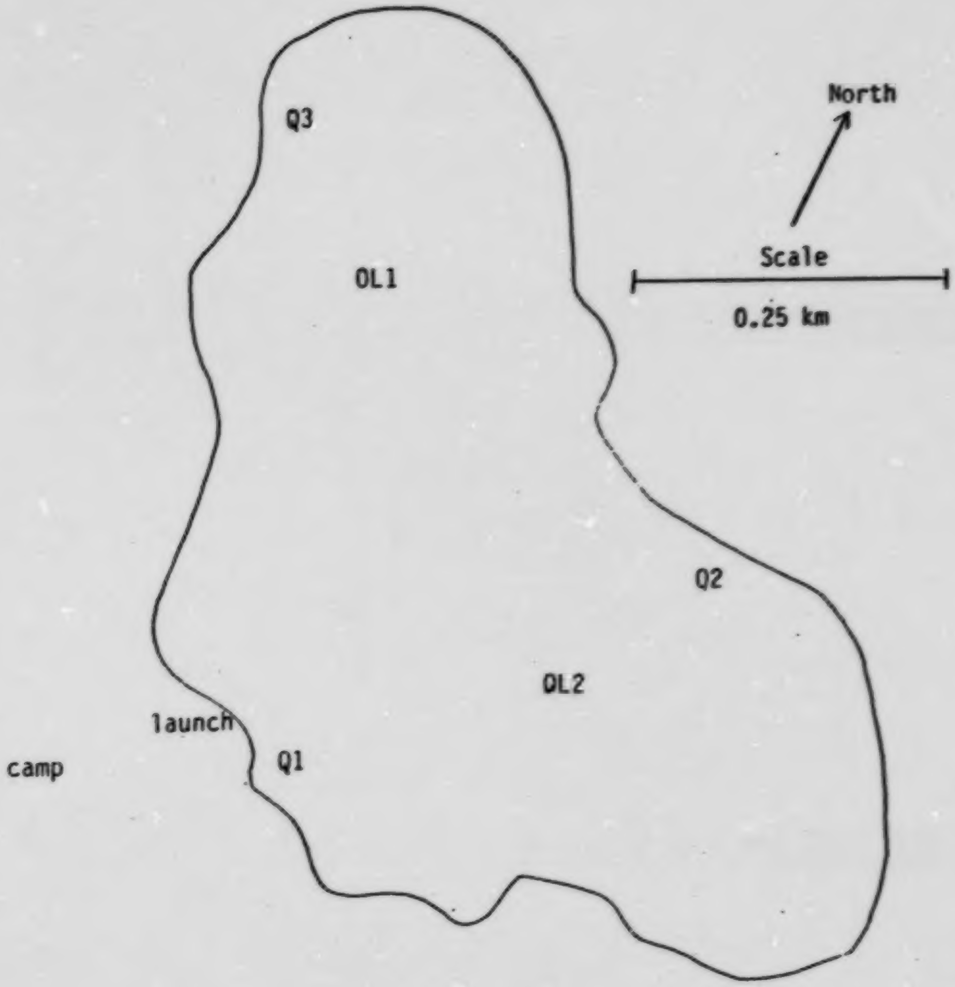
North
Scale
0.25 km
Q3
OL1
Q2
OL2
launch
Q1
camp

Figure 3. Sketch of Oyster Lake and sites sampled during August 1982 and August 1983. Qualitative (dip net) invertebrate sites are noted by Q#s, quantitative invertebrate (Ekman), phytoplankton, zooplankton, sediment and water quality sites are noted by OL#s.

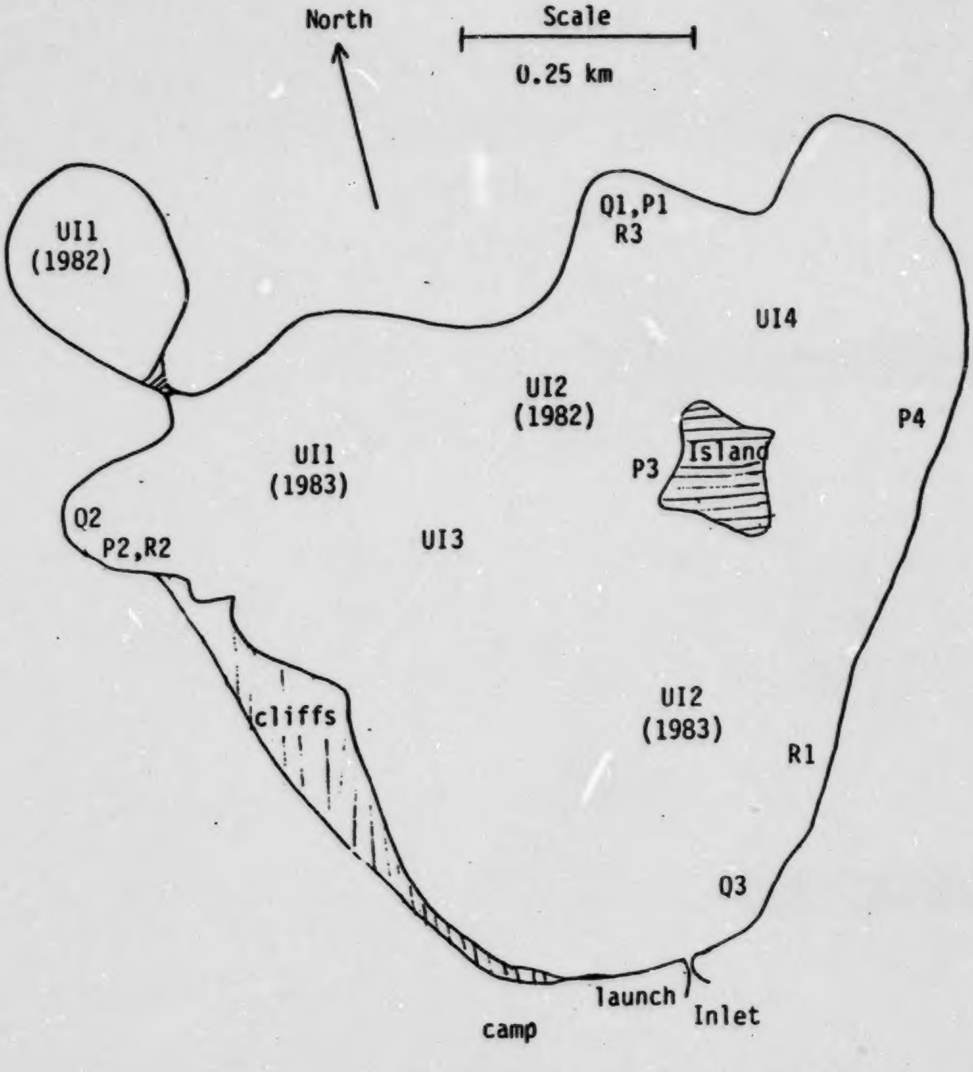
North
Scale
0.25 km
UI1
(1982)
Q1,P1
R3
UI4
UI2
(1982)
P4
Island
UI1
(1983)
P3
Q2
P2,R2
UI3
cliffs
UI2
(1983)
R1
Q3
launch
Inlet
camp

Figure 4. Sketch of Upper Island Lake and sites sampled during August 1982 and August 1983. Qualitative (dip net) invertebrate sites are noted by Q#s, quantitative invertebrate (Ekman), phytoplankton, zooplankton,, sediment and water quality sites are noted by UI#s, periphyton sites by P#s and 10-rock sites are noted by R#s.

METHODS AND MATERIALS

FIELD

Phytoplankton

Phytoplankton samples were obtained from the limnetic sites using a 2-liter Van Dorn bottle. Single samples were taken near the surface (0.5 m depth), near the bottom (1 m above floor) and in the metalimnion, if present. Samples from all depths at each site were composited in a bucket and subsampled (1000 ml) for laboratory analyses. In addition, at the deep Upper Island Lake station (UI4), discrete samples were obtained from the epilimnion, metalimnion, and the hypolimnion. All 1983 samples were preserved with Acid-Lugol's solution (Vollenweider 1969). Samples collected in 1982 from Oyster Lake and Upper Island Lake and October collections from Ned Wilson Lake were preserved with Acid-Lugol's solution (Vollendwider 1969). Samples collected from Ned Wilson Lake in August 1982 were preserved with 5-percent Formalin solutions.

Periphyton

Periphyton (attached algae) growths were collected from submerged rocks usually taken at depth of less than 2 m. Three replicate rocks from each site were selected, measured (length, width, and height) and scraped within a sampler area formed by placing a flexible rubber ring (3772 mm^2) over the rock. The attached algae were rinsed off the scraped area into a shallow enamel pan and the algae and liquid were then rinsed into a 125-milliliter Nalgene bottle. Acid-Lugol's preservative was added to each sample to produce a final concentration of 1 to 5 percent depending upon algal biomass present.

Zooplankton

Three (vertical net tow) depth integrated samples were taken at each lake site to collect zooplankton. A standard, 80-micrometer, Wisconsin plankton net was lowered to the bottom then raised to the surface. All samples were preserved in a 5-percent formalin solution.

Macroinvertebrates

Macroinvertebrates were sampled in soft sediment zones from each lake with an Ekman dredge. Sediments and organisms were separated in the field using a 570-micrometer, sieve bottom bucket. All macroinvertebrates were preserved in plastic Whirlpak bags with 10-percent formalin. Invertebrates in the littoral zone (shore to a depth of 1 meter) were sampled qualitatively with a 570-micrometer mesh triangular dip net. Ten rock samples were collected from sites noted in Ned Wilson and Upper Island Lakes (Figures 2 and 4) by scraping the entire surface of the individual rocks (into a white pan and condensing into Whirlpaks). The three dimensions of the rocks were recorded to enable rock area and standing crop estimation. Additionally, basket samplers and Hester-Dendy samples deposited by J. Turk approximately one month prior to this survey were retrieved, rinsed and sample debris preserved in 10-percent formalin.

Fish

Fish were collected for analyses of heavy metal content of whole fish tissues. During 1982, John Turk (USGS) used a gill net to collect six brook trout from Ned Wilson Lake. In 1983, six additional fish were collected in Ned Wilson Lake and two in Upper Island Lake using hook and line. Specimens were placed in ethyl alcohol and/or on ice or snow when available.

Chlorophyll a

Chlorophyll a samples were taken from depth integrated composite samples obtained for phytoplankton analyses. Triplicate 1-or 2-liter samples were filtered through GF/C filters pretreated with two drops of saturated $MgCO_3$ solution. Filters were stored on ice in the field until they could be frozen. Although immediate freezing is recommended (APHA 1980), this was not possible, and data should be interpreted accordingly.

Sediments

One sediment sample was collected at each Ekman site and split into three replicates at the surface. Sediments were placed in Whirlpak containers on ice or in cold water and returned to Lockheed-EMSCO (LEMSCO) for metal analysis.

Water Quality

Three depth-integrated replicates were collected from all limnetic sites for analyses of parameters listed in Table 2. A hand pump was used to vacuum water through 0.45-micrometer Nucleopore membrane filters to obtain dissolved fractions. Samples were preserved appropriately for each parameter according to U.S. EPA (1983) and APHA (1980) methods. Samples were placed in Nalgene containers and, with the exception of total and dissolved organic carbon (TOC and DOC), returned to LEMSCO, Las Vegas for analysis. TOC and DOC water samples were shipped to Dr. A. Lingg at the University of Idaho, Moscow for analyses. Some parameters, as noted, could not be processed within the time limit suggested for storage by U.S. EPA (1983). Field measurable parameters were analyzed on site with a Hydrolab 8000 (pH, temperature, conductivity and dissolved oxygen), by titration (alkalinity), or by use of the platinum-cobalt scale (color). The two latter parameters were measured with Hach kits.

LABORATORY

Phytoplankton

Phytoplankton enumeration and taxonomic identification were performed using an Olympus IMT inverted microscope and the procedures of Utermöhl (1958).

Phytoplankton were concentrated by sedimenting ten or fifty ml of sample for 24 hours. Nanoplankton (cells less than 64 μm) were counted at 400X magnification in strips across the entire diameter of the plate chamber. Net plankton were counted at either 100X or 200X magnification.

Counting and identification procedures included two steps. One subsample was acid-cleaned for diatom species identification and proportional counts under 1000X magnification using methods recommended by Weitzel (1979). The second subsample was examined with an inverted microscope at 100 to 400X magnification to count and identify non-diatoms (greens, blue-greens, euglenoids, cryptomonads, chrysophytes, and dinoflagellates) and to obtain a total count of all viable diatom frustules to convert proportional diatom counts to cells per mm^2. Specific calculations may be obtained from La Point et al. (1983) or Baldigo et al. (1983).

Zooplankton

Each zooplankton sample was thoroughly mixed and a one ml subsample removed with a large bore Stempel pipet and placed into a Sedgewick Rafter counting chamber. Enumeration was done under 40X magnification. The entire chamber was counted for each of three replicate 1-milliliter subsamples. Copepods were dissected and mounted in Hoyer's mounting media to aid in species identification. Counts were converted to relative abundances based on five abundance classes [abundant (61-100%), very common (31-60%), common (6-30%), occasional (1-5%) and rare (<1%)]. In 1983, sample counts were converted to aerial estimates (number/m^2) based on the known area of Wisconsin net and sample volume. Aerial estimates were not determined in 1982 because sample volumes were not measured, hence, results are only qualitative.

Macroinvertebrates

All invertebrate samples were wet sieved through a 570-micrometer mesh net in the laboratory. Invertebrates retained were picked from associated debris until none could be found during a five-minute scan. Finally, all collected debris was scanned under 10X magnification to locate any overlooked specimens. Organisms were identified to the lowest taxon possible utilizing current literature. Specimens of each genera and species were confirmed by experts.

Macroinvertebrate community indices from the benthos (quantitative-Ekman samples) were calculated to provide reference points to compare 1982, 1983, and future collections. The four indices consist of Shannon-Weiner Diversity (H') (Shannon and Weaver 1949),

$$H' = \sum_{i=1}^{s} p_i (\log_2 p_i),$$

where: H' = diversity index
s = number of species
i = species number ($i=1, 2, 3, \ldots S$)
p_i = proportion of individuals from the total sample belonging to the ith species.

There are two components of diversity: richness and evenness. Evenness, V, (Pielou 1977) is defined as:

$$V = \frac{H'}{\log_2 s}$$

Richness simply is the number of taxa sampled.

A fourth commonly used index of community diversity is Simpson's Dominance (D) (Simpson 1949). It is the probability of selecting two specimens from the same species when sampling randomly from a community. More specifically, dominance is defined as:

$$D = 1 - \sum_{i=1}^{s} (p_i)^2$$

Fish

All fish were frozen upon return to Las Vegas, and length and weight recorded. They then were liquefied and the aliquots were freeze dried. Lockheed-EMSCO personnel analyzed all fish tissue samples: Be, Cr, Zn, Ni, Cu and Ag via Inductively Coupled Plasma (ICP) Atomic Emission Spectrometric Method for Trace Element Analysis (U.S. EPA 1979, Alexander and McAnulty 1981); As, Se, Tl, Sb, Pb and Cd via Atomic Absorption Spectrophotometry (AA). Metal concentrations were equilibrated to tissue levels as mg/kg.

Chlorophyll a

Chlorophyll a was analyzed at the University of Nevada, Las Vegas (UNLV) by Dr. L. Paulson, Department of Biological Sciences, using the methods of Strickland and Parsons (1972). Results are reported as uncorrected chlorophyll a (µg/l) because very low levels precluded correction for phaeophytin.

Sediments

Sediment samples were acid digested following procedures in U.S. EPA (1981). Metal concentrations, except arsenic and selenium, were measured by ICP; arsenic and selenium were measured by AA. Results were reported as mg of metal per kg of sediment.

Water Quality

Chemical parameters determined in the laboratory and analytical techniques are provided in Table 2. Sensitivity, detection limits, precision and accuracy of the techniques utilized are presented in U.S. EPA (1983).

TABLE 2. SAMPLE SIZES, PRESERVATION AND ANALYSIS METHODS FOR PHYSICAL AND CHEMICAL WATER QUALITY PARAMETERS MEASURED FROM FLAT TOPS LAKES, AUGUST 1983 (U.S. EPA 1983-approved methods).

Parameter	Sample Size (ml)	Preservation Method	Analysis
Temperature, pH Conductivity and D.O.	NA	NA	Hydrolab 8000
Alakalinity	100	NA	Hach-titration
Color	50	H_2SO_4 to $pH \le 2$, 4°C	Hach-Platinum/Cobalt
DOC (filtered)	25	H_2SO_4 to $pH \le 2$, 4°C	P-O, Spec[1]
TOC	25	H_2SO_4 to $pH \le 2$, 4°C	P-O, Spec
Total Phosphorus	50	H_2SO_4 to $pH \le 2$, 4°C	P-O, Spec
Nitrate	25	H_2SO_4 to $pH \le 2$, 4°C	P-O, Spec
Nitrite	25	H_2SO_4 to $pH \le 2$, 4°C	P-O, Spec
Ammonia	50	H_2SO_4 to $pH \le 2$, 4°C	Tech AA, Color[2]
Sulfate	50	4°C	Tech AA, Color
Chloride	50	4°C	Tech AA, Color
Fluoride	50	4°C	Tech AA, Color
Chlorophyll *a*	2000	$MgCO_3$ and 4°C	Spectrophotometric
Total Metals	100	HNO_3 to $pH \le 2$	ICP and AA as:
Al, Zn, Cu, Cr, Ca			AA-Flame[3]
Cd, Pb, Se, As			AA-Furnace[4]
Mn, Mg, Ag, Fe, Ni			ICP[5]

Note 1. Persulfate-Oxydation (Spectrophotometric).
Note 2. Technicon-AutoAnalyzer (Colormetric).
Note 3. Atomic Absorption-Flame Technique.
Note 4. Atomic Asorption-Furnace Technique.
Note 5. Inductively Coupled Plasma Atomic Emission Spectrometric Method for Trace Element Analysis.

RESULTS AND DISCUSSION

This section presents the results of the 1982-83 Flat Tops lakes sampling efforts and discusses the findings in terms of parameter distributions, confidence in data and sensitivity of various parameters to acidification. Based on these findings, individual parameters are discussed in terms of their appropriateness for inclusion in monitoring programs designed to depict and quantify changes in high altitude lakes.

PHYTOPLANKTON

Relative Abundance and Distributions

Relative abundance of phytoplankton species are given in Tables 3 and 4, for 1982 and Tables 5, 6 and 7 for 1983. Species cell abundance are presented in Appendices A and B.

Ned Wilson Lake--

Ned Wilson Lake was sampled five times in 1982 (July 2 through September 3) and nine times in 1983 (April 4 through September 28). In both years, species richness was high in Chlorophyta (green algae) and Bacillariophyceae (diatoms) (Tables 3 and 5). Species richness was low for all other algal divisions. Chlorophyta were numerically dominant throughout 1982 with *Monoraphidium setiforme*, *Sphaerocystis schroeteri*, *Elakatothrix gelatinosa* and *Dictyosphaerium ehrenberigianum* the most common species. Pyrrhophyta (dinoflagellates), Cryptophyta (cryptomonads), Chrysophyceae (yellow-brown algae), Bacillariophyceae (diatoms), and Cyanophyta (blue-green algae) species were generally rare. Species assemblages were quite different in 1983 with Chlorophyta and Chrysophyceae being co-dominant for most of the time period. Principal Chlorophyta species were *Sphaerocystis schroeteri*, *Dictosphaerium ehrenberigianum*, *Nephrocytium* sp., and *Kirchneriella* spp. Principal Chrysophyceae species were *Chrysochromulina parva* and *Dinobryon cylindricum*.

Oyster Lake--

Oyster Lake was sampled once in 1982 (August 18) and three times in 1983 (August 19 through September 30). Species richness was high in Chlorophyta and Bacillariophyceae and low in the other algal divisions (Tables 4 and 6). *Tetraspora lacustris* (Chlorophyta) and *Chrysochromulina parva* (Chrysophyceae) were numerically co-dominant in 1982. In 1983, *Spaerozoma vertebratum*, *Sphaerocystis schoeteri* (Chlorophyta) and *Chrysochromulina* spp. were numerically most abundant.

TABLE 3. PHYTOPLANKTON SPECIES COMPOSTIION, TOTAL CELL ABUNDANCE (Cells/ml). SPECIES RICHNESS, AND RELATIVE CELL ABUNDANCE IN NED WILSON LAKE, COLORADO, 1982. A = Abundant (61-100%), VC = Very Common (31-60%), C = Common (6-30%), 0 = Occasional (1-5%) and R = Rare (<1%).

	07-21[1]	08-04	08-17-82				09-10	10-03[2]
	5'	10'	NW1	NW2	NW3	NW4	10'	
Chlorophyta								
Ankistrodesmus nannoselene		0						
Chlamydomonas sp. (<5m)								R
C. dinobryonii								0
Chlorogonium sp.						R		
Cosmarium suecicum			R		R			
Crucigenia rectangularis		C	0	R	R	0	0	
Dictyosphaerium ehrenbergianum		C	C	C	C	C	C	VC
Elakatothrix gelatinosa		0	VC	VC	C	VC	R	C
Euastrum sp.			R					
Kirchneriella contorta		C	0	0	0	0	R	
K. obesa var. *major*				R	0	0	R	
Micrasterias sp.					R			
Monoraphidium setiforme	VC	R						
Nephrocytium agardhianum			C	C	C	C	VC	0
Pedinomonas minutissima								0
Scenedesmus bijuga		0						
S. quadricauda					R			
Selenastrum minutum		0	0	0	R	0	C	C
Sphaerocystis schroeteri		VC	C	VC	C	C		
Pyrrhophyta								
Gymnodinium sp.						R		R
G. ordinatum								0
Peridinium willei								R
Cryptophyta								
Cryptomonas erosa								R
Katablepharis ovalis								0
Rhodomonas minuta				R				
Chrysophyceae								
Chrysochromulina parva		R	R					0
Dinobryon divergens			R	R		0		R
Kephyrion sp.								R
Pseudokephyrion sp.								R
Pseudopedinella erkensis								0
Ochromonas sp.								0

continued

TABLE 3. Continued.

	07-21[1]	08-04	08-17-82				09-10	10-03[2]
	5'	10'	NW1	NW2	NW3	NW4	10'	
Bacillariophyceae								
Cyclotella sp.					R	R	R	R
C. pseudostelligera								
C. stelligera		O						
Cymbella minuta		R			R			
Fragilaria crotoensis		R						
F. construens var. *venter*					R			
Navicula notha		O			R			
N. radiosa var. *parva*			R		R	R		
N. minima								
Nitzschia kutzingiana					R			
Pinnularia sp.		R			R			
Stauroneis ancepts var. *gracilis*					R			
Synedra spp.		R						
Tabellaria flocculosa		R						
Cyanophyta								
Dactylococcopsis irregularis	VC							
Merismopedia tenuissima				O				
Spirulina sp.					R			
Misc.								
Monads (<5 µm)								C
Total Cell Abundance (cells/ml)	20	357	1906	2166	2864	2616	3530	2869
Species Richness	2	17	12	11	20	13	8	19

Note 1. Depth or site is noted below each date.

Note 2. All samples preserved with formalin except on 10/03/82.

TABLE 4. PHYTOPLANKTON SPECIES COMPOSITION, TOTAL CELL ABUNDANCE (cells/ml), SPECIES RICHNESS, AND RELATIVE CELL ABUNDANCE IN OYSTER LAKE^1 AND UPPER ISLAND LAKE, COLORADO, 1982. A = Abundant (61-100%), VC = Very Common (31-60%), C = Common (6-30%), O = Occasional (1-5%) and R = Rare (<1%).

	Oyster Lake		Upper Island Lake			
	OL1	OL2	UI1	UI2	UI3	UI4
Chlorophyta						
Ankyra judayi					R	
Ankistrodesmus nannoselene			VC	VC	VC	C
Chlamydomonas sp.	C			O	R	R
Chlorogonium sp.	O					
Crucigenia rectangularis		C				
Dictyosphaerium ehrenbergianum				C		O
Elakatothrix gelatinosa			O	C	C	C
Monoraphidium pusillum			O	C		C
Oocystis lacustris		O				
Pediastrum boryanum				R		
Scenedesmus bijuga				R	O	
Spirogyra sp.				O	R	R
Staurastrum sp.			R	R	R	
Tetraspora lacustris	C	A	C			
Pyrrhophyta						
Gymnodinium sp.					R	R
Peridinium willei			R	R	R	R
Cryptophyta						
Cryptomonas sp.			R			
C. pyrenoidifera						
C. reflexa	O		O	R	O	
Katablepharis ovalis	C			R		R
Rhodomonas minuta	O		C	C	C	VC
Chrysophyceae						
Chrysochromulina parva	VC		C	C	C	
Ochromonas sp.				R		
Bacillariophyceae						
Achnanthes lanceolata var. *dubia*		R				
A. lanceolata var. *lanceolatoides*	R					
Cyclotella sp.		R				
C. stelligera			O	R	O	O
Cymbella minuta		R		R		
Diatoma hiemale var. *mesodon*		R				

continued

TABLE 4. Continued.

	Oyster Lake		Upper Island Lake			
	OL1	OL2	UI1	UI2	UI3	UI4
Bacillariophyceae (Cont.)						
Fragilaria pinnata	R	R				
Gomphonema sp.	R	0				
G. gibba		R				
Meridion circulare var. *constrictum*		R				
Navicula sp.					R	
N. notha		R	R			
N. pupula var. *rectangularis*	R					
N. radiosa	R	0				
N. atomus		R				
N. minima	R	R				
Nitzschia sp.	R			0	R	R
N. acicularis				R		
N. kutzingiana			R			
Pinnularia sp.	R	0		0	0	
Synedra spp.				R	0	
S. radians	R					
Tabellaria flocculosa		R				
Stauroneis ancepts		R				
Cyanophyta						
Anabaena sp.	R					
Oscillatoria sp.			R	R	R	
O. limnetica					R	
Misc.						
Monads (<5 µm)				R	0	0
Total Cell Abundance (cells/ml)	964	670	762	1049	580	678
Species Richness	17	18	14	23	20	13

Note 1. See Appendix A for dates.

TABLE 5. PHYTOPLANKTON SPECIES COMPOSITION, TOTAL CELL ABUNDANCE (cells/ml), SPECIES RICHNESS AND RELATIVE ABUNDANCE IN NED WILSON LAKE, 1983. A = Abundant (61-100%), VC = Very Common (31-60%), C = Common (6-30%), 0 = Occasional (1-5%) and R = Rare (<1%).

Taxon	04-14	06-28	07-20	07-29	08-12	08-17	08-25-83				09-10	09-28
							NW1	NW2	NW3	NW4		
Chlorophyta												
Chlamydomonas spp.	R	R	0	C								
Cosmarium nanum				R								
Crucigenia rectangularis					R							
Dictyosphaerium sp.										0		
Dictyosphaerium ehrenbergianum		A			C	VC	C	C	VC	VC	VC	C
Elakatothrix gelatinosa					C			0	R	0	C	
Golenkinia sp.				0								
Kirchneriella spp.											0	
Nephrocytium sp.			0	VC	C	C	0			R		A
Oedogonium sp.										R		
Oocystis borgei											C	
Pediastrum spp.										R		
Pediastrum boryanum									R	R		
Schaerocystis schroeteri	A						R				0	
Schroederia setigera		R	R						R		C	R
Staurastrum proboscidium										R		
Xanthidium smithi				0								
Euglenophyta												
Trachelomonas robusta					0							
Pyrrhophyta												
Ceratium sp.										R		
Glenodinium gymnodinum			R									
Glenodinium oculatum			R									
Gymnodinium spp.	R											R
Gymnodinium ordinatum		R	0	C	0						R	
Peridinium quaridens			R	R								
Cryptophyta												
Crytomonas erosa			0									
Rhodomonas minuta	R											

continued

20

TABLE 5. Continued.

Taxon	04-14	06-28	07-20	07-29	08-12	08-17	08-25-83				09-10	09-28
							NW1	NW2	NW3	NW4		
Chrysophyceae												
Chrysochromulina sp.		O								C		
Chrysochromulina parva			VC	C		C	VC	C	C		C	O
Dinobryon cylindricum				O	VC	VC	VC	VC	VC	VC	O	R
Ochromonas spp.					C							
Bacillariophyceae												
Cocconeis diminuta										R		
Cyclotella spp.			VC									
Cymbella spp.	R							R			R	
Fragilaria spp.							R					
Gomphonema angustatum					O							
Hantzschia spp.				O			R					
Navicula spp.										R	R	
Navicula cryptocephala				R	O		R	R	R			
Nitzschia spp.										R		
Nitzschia kutzingiana									R			
Nitzschia palea						R	R		R	R		
Tabellaria sp.											R	
Tabellaria flocculosa						R	R	O		R		
Tabellaria fenestrata												R
Cyanophyta												
Anabaena sp.					R	R	R	R	R	O	R	
Merismopedia tenuissima	R											
Phormidium mucicola		O	R									
Total Cell Abundance	37500	11230	2494	429	976	660	2392	1623	1564	2598	2580	6438
Species Richness	6	6	11	11	11	7	12	8	12	16	13	7

TABLE 6. PHYTOPLANKTON SPECIES COMPOSITION, TOTAL CELL ABUNDANCE (cells/ml), SPECIES RICHNESS AND RELATIVE CELL ABUNDANCE IN OYSTER LAKE, 1983. A = Abundant (61-100%), VC = Very Common (31-60%), C = Common (6-30%), O = Occasional (1-5%) and R = Rare (<1%).

Taxon	08-19	08-23-83		09-1	09-30
	buoy[1]	OL1	OL2	buoy[1]	buoy[1]
Chlorophyta					
Ankistrodesmus spiralis			O		
Chlamydomonas sp.					R
Cosmarium spp.	R			R	C
Crucigenia rectangularis	C	O	C	O	
Dictyosphaerium ehrenbergianum					C
Elakatothrix gelatinosa			R		R
Gonatozygon sp.		R	R		
Oocystis borgei				O	R
Pedinomonas minutissima	O				C
Quadrigula sp.			R		
Spaerozoma verbratum	A				
Schroederia setigera		O	C	R	C
Spaerocystis schroeteri	C	VC		A	C
Staurastrum spp.	R	O	R	R	R
Staurastrum gracile		R			O
Tetraspora sp.				O	
Pyrrhophyta					
Gymnodinium spp.				O	
Peridinium quaridens				R	
Cryptophyta					
Cryptomonas erosa				R	R
Katablepharis ovalis				C	
Rhodamonas minuta	C	C	C	C	C
Chrysophyceae					
Chrysochromulina sp.	O			O	VC
Chrysochromulina parva	O		VC		
Bacillariophyceae					
Amphora ovalis	R				
Cyclotella spp.		R	R		R
Cymbella spp.		R	R		R
Cymbella minuta		O			O
Fragilaria spp.	R				
Frustulia vulgaris			R		
Navicula spp.	R		R		R
Navicula bacillum		O			
Navicula cryptocephala				R	

continued

TABLE 6. Continued.

Taxon	08-19 buoy[1]	08-23-83 OL1	 OL2	09-1 buoy[1]	09-30 buoy[1]
Bacillariophyceae (continued)					
Navicula pupula			R		
Navicula radiosa			R		
Nitzschia palea	O	O			
Synedra spp.		R	R		
Synedra delicatissima				R	
Tabellaria sp.				R	
Tabellaria flocculosa	R		R		
Cyanophyta					
Anabaena sp.	R	C			R
Phormidium spp.			R		
Total Cell Abundance (cells/ml)	1486	606	1409	2778	1988
Species Richness	15	14	17	16	17

Note 1. USGS buoy approximately mid lake, between 011 and 012.

Upper Island Lake--

Upper Island Lake was sampled once in 1982 and five times in 1983 (August 10 through September 21) at two-week intervals. As in the other lakes, species richness was highest in Chlorophyta and Bacilloriophyceae. Ankistrodesmus nannoselene (Chlorophyta) and Phodomonas minuta (Cryptophyta) were the numerically co-dominant species in 1982 (Table 4). Dactylococcopsis raphidiodes, a blue-green algae (Cyanophyta), was numerically dominant on August 10, 1983, but was succeeded by Elakatothrix gelatinosa (Chlorophyta), which remained dominant from August 24 through September 21, 1983 (Table 7).

Confidence in Data and Monitoring Value

Phytoplankton identifications were made by different individuals in 1982 and 1983, and part of the yearly differences in species assemblages in all three lakes may be due to taxonomic uncertainties. Species identification confirmations were not made between phycologists participating in the study, therefore, confidence in species identifications is not known.

TABLE 7. PHYTOPLANKTON SPECIES COMPOSITION, TOTAL CELL ABUNDANCE (Cells/ML), SPECIES RICHNESS AND RELATIVE CELL ABUNDANCE IN UPPER ISLAND LAKE, 1983. [A = Abundant (61-100%), VC = Very Common (31-60%), C = Common (6-30%), O = Occasional (1-5%) and R = Rare (<%)].

Taxon	08-10	08-24	08-27-83				09-08	09-21
			UI1	UI2	UI3	UI4		
Chlorophyta								
Cosmarium spp.							R	
Dictyosphaerium ehrenbergianum						R	R	O
Elakatothrix gelatinosa	O	VC	A	A	A	A	A	A
Gonatozygon sp.		R				R		R
Kirchneriella spp.							R	
Oedogonium sp.			R				R	
Pedinomonas sp.	R			O	R	R		
Pedinomonas minutissima		C					O	O
Schroederia setigera		R			O		R	R
Sphaerocystis schroeteri		C	C	O	R	O	R	O
Selenastrum minutum								R
Staurastrum spp.			R					
Staurastrum gracile					R	R		
Staurastrum paradoxm								R
Staurastrum proboscidium						R		
Tetraedron regulare					R			
Pyrrhophyta								
Peridinium cinctum			R					R
Peridinium willei			R					
Cryptophyta								
Cryptomonas erosa		R	R	R	R	R	R	R
Katablepharis ovalis		O					O	
Rhodomonas minuta	O	O	O	O	O	O	R	R
Chrysophyceae								
Chrysochromulina parva		R	O	O	R	O	O	C
Ochromonas spp.							R	

continued

TABLE 7. Continued

Taxon	08-10	08-24	08-27-83 UI1	UI2	UI3	UI4	09-08	09-21
Bacillariophyceae								
Asterionella formosa					R			
Cyclotella sp.	C		R	R				
Cymbella sp.				R	R		R	R
Fragilaria brevistrata						R		
Fragilaria crotonensis	R			R		R		
Gomphonema gibba								R
Melosira islandica			R					
Navicula pupula					R		R	
Nitzschia spp.					R		R	R
Nitzschia holsatica			R					
Nitzschia palea		R						
Opephora sp.						R		
Pinnularia borealis					R			
Synedra spp.			R					
Tabellaria flocculosa			R					
Cyanophyta								
Anabaena sp.	R				R	R	O	
Dactylococcopsis raphidiodes	C	C						
Lyngbya sp.			R					
Oscillatoria spp.				R		R		
Raphidopsis curvata			R	O	O	R		
Total Cell Abundance (cells/ml)	6164	4370	7443	9805	6302	9533	16,630	9550
Species Richness	7	11	16	11	16	16	17	15

Between-station variability in phytoplankton assemblages were noted within each of the three lakes (Tables 3-7). These differences were largely restricted to rare species. Dominant and co-dominant species were generally consistent among stations within each lake.

Vertical variations in phytoplankton assemblages were also found. Discrete samples were taken at depths of 1, 5 and 10 m from Upper Island Lake on August 27, 1983. Phytoplankton assemblages were somewhat different at these depths with higher species richness and cell abundance at 1 m (Appendix B). Again, dominant and co-dominant species were similar at each depth, but there were shifts in the abundance and occurrence of rare species.

Quantification of rare phytoplankton species, for any one period, would require analyses of a large number of samples, collected at various depths and locations. This would not be feasible in future routine monitoring of these lakes. However, it does appear that replicate (3 to 5) analyses of a composite sample consisting of depth integrated samples collected from various areas of a lake will characterize the major components (dominant and co-dominant species) of the phytoplankton communities for any single time period. Number of sampling areas used in the composite sample should be further investigated, but two to four areas appear to be sufficient based on results from the three Flat Tops lakes.

Of greater concern, is the high seasonal and annual variation (Tables 3-7) exhibited by the phytoplankton in each of these lakes. It is obvious that any one sampling period, at turnover (spring or fall) or during thermal stratification, will not be adequate in characterizing phytoplankton occurrence, abundance or species richness relative to potential changes from acidification. It is also obvious that phytoplankton will be better represented with more frequent sampling. Subjectively, biweekly or monthly sampling periods over the ice free period may be adequate, but this will require further investigation. However, even if monthly sampling proves to be sufficient, sampling at this frequency may not be possible in routine monitoring programs.

Sensitivity to Acidification

Reported effects of acidification on phytoplankton vary, but decreases in species richness and diversity are typical in most lakes undergoing acidification (Tonnessen 1984, Conway and Hendrey 1982, Yan 1979, Yan and Stokes 1978, Kwiatkowski and Roff 1976). Chlorophyta and Bacillariophyceae species are generally very acid sensitive and marked reduction in species richness occurs in these groups in the range of pH 5.0 to 6.0 (Conway and Hendrey 1982). Dinophyceae (Pyrrhophyta) species usually increase in species richness and abundance, and dominate in acid lakes. However, species of Chrysophyceae and Cyanophyta have become dominant in some lakes (Conway and Hendrey 1982, Kwiatkowski and Roff 1976).

In the Flat Tops lakes, Chlorophyta are generally the most abundant and diverse algae. Their abundance would likely decrease with acidification. Chrysophyceae, at times, are numerically dominant in these lakes, and they may become of greater importance with acidification. Primary indicator species increasing in abundance with acidification will probably be in the division Pyrrhophyta, (Conway and Hendrey 1982).

PERIPHYTON

Periphyton analysis at present is incomplete. These data will be available upon completion by contacting W. Kinney, EMSL-LV or B. Baldigo, Lockheed-EMSCO. Responses of the periphyton community to acidification have been documented (Stokes 1984) and appear to be potentially useful monitoring parameters for high altitude lakes.

ZOOPLANKTON

Relative Abundance and Distributions

Relative abundance of zooplankton species found in Ned Wilson, Oyster, and Upper Island Lakes for 1982 and 1983 are presented in Tables 8, 9 and 10, respectively. Quantitative data for individual taxa analyzed in 1983 are given in Appendix C.

TABLE 8. ZOOPLANKTON RELATIVE ABUNDANCE IN NED WILSON LAKE (1982-1983). A = Abundant (61-100%), VC = Very Common (31-60%), C = Common (6-30%), 0 = Occasional (1-5%) and R = Rare (<1%).

Ned Wilson Lake

	08-17-82				08-25-83			
Taxon	NW1	NW2	NW3	NW4	NW1	NW2	NW3	NW4
Cladocera								
Holopedium gibberum	0	0	R	0	0	R	R	0
Ceriodaphnia quadrangula			R					
Daphnia pulex								R
Copepoda								
Diaptomus coloradensis	0	0	0	0	0	0	0	0
(adult)								
Copepodid	0		R		0	0	0	R
Nauplius	R	R	R	R	C	0	0	0
Rotifera								
Keratella cochlearis	A	A	A	A	VC	A	VC	A
Conochilus unicornis	0	VC	C	VC	VC	C	VC	C
Polyarthra spp.			R	R	R	R	R	R
#/m^2 x 1000 All taxa[1] (1983)					2108	2138	1950	2108

Note 1. Quantitative data unavailable for 1982.

TABLE 9. ZOOPLANKTON RELATIVE ABUNDANCE IN OYSTER LAKE (1982-1983). A = Abundant (61-100%), VC = Very Common (31-60%), C = Common (6-30%), O = Occasional (1-5%) and R = Rare (<1%).

Oyster Lake				
	08-18-82		08-23-83	
Taxon	OL1	OL2	OL1	OL2
Cladocera				
Holopedium gibberum	R	O		
Daphnia pulex	O		O	O
Copepoda				
Diaptomus coloradensis (adult)	O	O	O	O
Diaptomus shoshone (adult)			R	R
Copepodid	O	O	C	C
Nauplius	C	C	VC	VC
Rotifera				
Keratella cochlearis	C	VC	VC	VC
Polyarthra spp.	C	O	R	R
Conochilus unicornis	VC	VC	C	C
#/m^2 x 1000 All taxa^1 (1983)			343	599

Note 1. Quantitative data unavailable for 1982.

During both years rotifers were the dominant group both in species richness and numbers in all lakes. *Keratella cochlearis* and *Conochilus unicornis* were the numerically co-dominant species in all lakes. *Polyarthra* spp. were also abundant in Upper Island Lake. Zooplankton species richness was highest in Upper Island Lake due to the occurrence of three rotifers, *Keratella quadrata*, *Filinia terminalis* and *Asplanachna periodonta*, which were not found in the other lakes.

Copepods were the most depauparate zooplankton group. Only one species, *Diaptomus coloradensis*, was found in Ned Wilson Lake, and *Diaptomus arapahoenis* was the only copepod found in Upper Island Lake. Two copepods were found in Oyster Lake, *D. coloradensis*, and the very large species, *Diaptomus shoshone*. The latter was found only during 1982. Relative abundance for all species was low except for the common occurrence of *D. arapahoenis* in Upper Island Lake and the relatively high abundance of immature stages (copepodids and nauplii) in Oyster Lake.

Species richness and abundance of cladocerans were also low in all lakes. Three species were found in Ned Wilson and Upper Island Lakes and two species

TABLE 10. ZOOPLANKTON RELATIVE ABUNDANCE IN UPPER ISLAND LAKE (1982-1983). A = Abundant (61-100%), VC = Very Common (31-60%), C = Common (6-30%), O = Occasional (1-5%) and R = Rare (<1%).

	Upper Island Lake							
	08-20-82				08-26 - 27-83			
Taxon	UI1	UI2	UI3	UI4	UI1	UI2	UI3	UI4
Cladocera								
Daphnia rosea	R					R	O	O
Ceriodaphnia quadrangula	C	C	C	C	C	C	C	C
Chydorus sphaericus						R		
Copepoda								
Diaptomus arapahoensis (adult)	C	C	C	C	O	O	C	C
Copepodid	O	O		O	O	R	R	O
Nauplius				R	O	R	O	O
Rotifera								
Keratella cochlearis		O	O	R	C	C	C	O
Keratella quadrata	O		R	O	R	R	R	C
Filinia terminalis	O							O
Asplanachna periodonta								R
Polyarthra spp.	R		R	R	C	C	VC	O
Conochilus unicornis	A	A	A	A	A	VC	VC	C
#/m^2 x 1000 All taxa[1] (1983)					44	233	223	546

Note 1. Quantitative data unavailable for 1982.

in Oyster Lake (Tables 8, 9, and 10). There was only one relatively abundant cladocern, Ceriodaphnia quadrangula, found in Upper Island Lake. Other cladocerns were Holopedium gibberum and Daphnia pulex found in both Ned Wilson and Oyster Lakes. Daphnia rosea and Chydorus sphaericus were restricted to Upper Island Lake.

Annual differences in zooplankton community structure were very slight and were primarily related to the occurrence or absence of rare species. Relative abundance for dominant and co-dominant species in 1982 and 1983 were very similar in each of the lakes. The only exception was Upper Island Lake where there were some shifts in rotifer species abundance between years.

Zooplankton numbers were highest in Ned Wilson Lake (Table 8) and no significant difference ($\alpha \geq 0.05$, ANOVA) was found in numbers at stations sampled in 1983. Total numbers of zooplankton were similar in Upper Island and Oyster Lakes (Tables 9 and 10), but were substantially lower than in Ned Wilson Lake. Zooplankton numbers were significantly different between stations in both Upper Island and Oyster Lakes. In Upper Island Lake, species richness and numbers were highest at the deepest station (Station UI4). Only one additional species was found at the other stations, but it was rare. Oyster Lake was shallow, and differences in total numbers were not due to depth. However, species richness was identical at both stations in Oyster Lake. Relative to all three lakes, replicate depth integrated samples taken at a single station located at the deepest point of the lake would probably characterize the zooplankton community with little or no loss of information.

All zooplankton species found in the Flat Tops lakes have a wide geographical distribution except the three copepod species, *D. arapahoenis*, *D. coloradensis* and *D. shoshone*. These species are restricted to high altitude lakes in the Rocky Mountains of Canada and the United States (Edmondson 1959). Dodson (1982) and Sprules (1972) have described crustacean zooplankton (cladocera and copepoda) assemblages in Mexican Cut Nature Preserve lakes. These authors found two distinct species associations related to lake depth and predator prey relationships. *Daphnia rosea*, *D. coloradensis* and *Chaoborus* spp. were found in large deep lakes; whereas, *D. pulex*, *D. coloradensis* and *Branchinects* spp. were found in shallow lakes. Similar species assemblages were found in the Flat Tops lakes, except *Chaoborus* spp. and *Branchinecta* spp. were absent. Also, *D. arapahoensis* rather than *D. coloradensis* was found in Upper Island Lake, a relatively deep lake (maximum depth 16 m) and *D. shoshone* was absent from Ned Wilson Lake, which was intermediate in depth (maximum depth 5 m). Species richness in the Flat Tops lakes was low, but crustaceans were similar to those reported by Dodson (1982) and Sprules (1972). Rotifer species were not reported by those authors.

Confidence in Data

Confidence in species identifications was high. All zooplankton identifications were based on keys in Edmondson (1959) and confirmations were by Gene Wilde, UNLV. There was apparently more than one species of the rotifer, *Polyarthra*, but these could not be distinguished. *Daphnia pulex* was the only questionable species having characteristics of both *D. pulex* and *D. middendorffiana*. Dodson (1982) and Sprules (1972) found similar mixed characteristics for specimens from high altitude Colorado lakes in the Mexican Cut Nature Preserve. Specimens from the Colorado Flat Tops had characteristics that were closest to *D. pulex*.

Sensitivity to Acidification

Malley et al. (1982) have suggested the following possible factors affecting zooplankton communities in acidified lakes:

1. increased temperatures as a result of increased transparency,
2. changes in food abundance and/or quality as a result of algal species shifts,
3. hydrogen ion toxicity,
4. metal toxicity,
5. changes in predator-prey relationships,
6. changes in zooplankton competition with the loss of competing species.

Consequently, effects are very complex and are interrelated throughout the entire aquatic ecosystem.

Very little information on acidification effects on zooplankton exists for the Western United States; however, effects of lake acidification on crustacean zooplankton in Canada and Northeastern United States have been well documented (Confer et al. 1983, Malley et al. 1982, Yan and Strus 1980, Roff and Kwiatkowski 1977, Sprules 1975). Effects on rotifers have largely been neglected and have only been reported by Tonnessen (1984) and Roff and Kwiatkowski (1977). The most evident effect of acidification in all lakes was a decrease in species richness associated with increased acidification. Major reductions in species richness occurred when pH decreased below 5.5 (Malley et al. 1982). Species richness in the Flat Tops lakes was naturally low and could not be compared to Eastern lakes. However, the few zooplankton species found will provide baseline data for future monitoring of these lakes. Sensitive species that may be lost with acidification are the two cladocerns, *D. pulex* and *D. rosea* (Malley et al. 1982). The other cladocerns, *H. gibberum*, *C. quadrangula* and *C. sphaericus* are tolerant to low pH (Malley et al. 1982, Fryer 1980). Sensitivity of the three copepod species (*Diaptomus* spp.) is not known. All rotifer species found in the Flat Tops lakes have been reported in acid lakes (Roff and Kwiatkowski 1977); however, Tonnessen (1984) reported decreased rotifer abundance in short term microcosm experiments in Sierra Nevada, California lakes. The numerically dominant rotifer communities in the Flat Tops lakes, may therefore, decrease in abundance with acidification.

MACROINVERTEBRATES

Relative abundance estimates for each taxon identified from quantitative (Ekman) samples from both 1982 and 1983 surveys are provided in Table 11. Qualitative sample, relative abundance estimates for each taxon are listed in Table 12. Quantitative raw data for 1982 and 1983 and qualitative data for 1982 and 1983 are provided in Appendices D, E, F and G, respectively.

Relative Abundance and Distributions

Ned Wilson Lake--

Quantitative samples from the benthos of Ned Wilson Lake during both 1982 and 1983 yielded 35 taxa with the pelecypoda, *Pisidium* sp., the most abundant single species (Table 11). The shoreline invertebrate community was much more diverse, yielding 46 taxa, 20 of which were not collected with the Ekman, with no single genus very common (Table 12). Among the shoreline fauna, the chironomids were the most diverse group, however, other orders not present in deep benthos occurred occasionally (Table 12). Species restricted to the shoreline included the caddisfly, *Psychoglypha subborealis*; water mite, *Lebertia* sp.; mayfly, *Callibactis coloradensis*; damselfly, *Enallagma boreale*; and many beetle larvae and adults and species of midges, (Tables 11 and 12). One fish gut, taken from a Ned Wilson Lake brook trout collected August 17, 1982, was also examined. It contained approximately 50-, 40-, 5- and 5-percent Simuliidae (Diptera), Hymenoptera, Homoptera and Coleoptera, respectively. All individuals within the trout gut were winged and most likely obtained while surface feeding.

TABLE 11. RELATIVE ABUNDANCE OF BENTHIC MACROINVERTEBRATES IN COLORADO FLAT TOPS LAKES EKMAN SAMPLES. A = Abundant (61-100%), VC = Very Common (31-60%), C = Common (6-30%), 0 = Occasional (1-5%) and R = Rare (<1%).

Taxon	Ned Wilson Lake		Oyster Lake		Upper Island Lake	
	1982	1983	1982	1983	1982	1983
Ephemeroptera						
Callibaetis coloradensis			R	R		
Caenis sp.			0	0		
Chironomidae						
Chironomidae - all	R					
Chironomidae - Tanypodinae						
Ablabesmyia sp.		R				
Procladius sp.	0	0	C	0	C	0
Chironomidae - Chironomini						
Chironomus sp. 1	C	C			0	R
Chironomus sp. 2					VC	C
Cryptochironomus sp.	R	R				
Dicrotendipes sp.	R		C	C		
Microtendipes sp. 1		0	0	0		
Polypedilum sp.			R	R		
Pseudochironomus sp.	R		VC	C		
Pagastiella sp.	R	0	0	C	R	
Phaenopsectra sp.					R	
Cladopelma sp.	R	0	R			
Chironomidae - Tanytarsini						
Tanytarsus sp.	R		0	VC		
Corynocera sp.	C	0			R	R
Lenziella sp.	C	C	R	R		

continued

TABLE 11. Continued.

Taxon	Ned Wilson Lake		Oyster Lake		Upper Island Lake	
	1982	1983	1982	1983	1982	1983
Chironomidae - Orthocladiinae						
Corynoneura sp.		R				
Heterotrissocladius sp.		R				
Psectrocladius sp. 2						R
Synorthocladius sp.	R					
Chironomini - Diamesinae						
Pseudokiefferiella sp.		R				
Ceratopogonidae						
Palpomyia sp.	R		O	O		
Coleoptera						
Hydroporus sp. 1			R			
Deronectes griseostriatus		R		R		
Cladocera						
Latona setifera			R	R		
Holopedium gibberum		R				
Daphnia pulex				R		
Ceriodaphnia quadrangula					R	
Ostracoda						
Candona scapulosa	C	C	R	R	C	R
Eucypris affinis hirsuta				R		
Copepoda						
Diaptomus coloradensis				R		
Diaptomus arapahoensis					O	
Diaptomus shoshone				R		
Macrocyclops albidus		R		R		
Cyclops vernalis		R				

continued

TABLE 11. Continued.

Taxon	Ned Wilson Lake		Oyster Lake		Upper Island Lake	
	1982	1983	1982	1983	1982	1983
Amphipoda						
Hyalella azteca			O	O		
Gammarus lacustris				R		
Nematoda						
Nematoda - all		R	O	O		
Oligochaeta						
Oligochaeta - all		R				
Naididae - all		R		R		
Nais spp.		R		R		
Uncinais uncinata	O	R	O	R	R	
Lumbriculidae - all	O	O	R	R		
Immature Tubificidae WOCC	C	C	R	R	C	VC
Immature Tubificidae WCC	R	R	R		O	C
Limnodrilus spiralis	O	R			O	C
Ilyodrilus templetoni			R		O	
Enchytraeidae, all	R		O	O		
Hirudinea						
Nephelopsis obscura			R	R		
Glossiphonia complanata			R			
Helobdella stagnalis	R	R				
Pelecypoda						
Pisidium sp.	VC	VC	C	O		

TABLE 12. MACROINVERTEBRATES OBSERVED IN COLORADO FLAT TOPS LAKES AND NED WILSON SPRING (QUALITATIVE SAMPLES) AND RELATIVE ABUNDANCE OF EACH TAXON. A = Abundant (61-100%), VC = Very Common (31-60%) C = Common (6-30%), O = Occasional (1-5%) and R = Rare (<1%).

Taxon	Ned Wilson Lake			Oyster Lake		Upper Island Lake	
	1982	1983	Spring	1982	1983	1982	1983
Ephemeroptera							
Callibaetis coloradensis		O			C		
Cloeon ingens					R		
Caenis sp.				C	R		
Odonata							
Enallagma boreale	R			R	R		
Hemiptera							
Arctocorisa sutilis				C	O		
Cenocorixa wileyae							R
Gerris sp.					O		
Tricoptera							
Limnephilus externus			O	R	R		
Limnephilus sp.			R	O			
Immmature *Limnephilidae*		O					R
Psychoglypha subborealis	C	O		O	O		O
Psychoronia costalis			R				
Chironomidae -Tanypodinae							
Ablabesmyia sp.		R					
Procladius sp.	C	C			C	O	C
Chironomidae - Chironomini							
Cryptochironomous sp.			R		R		
Dicrotendipes sp.	R		R	O	R		
Glyptotendipes sp.			R				
Microtendipes sp. 1		C			R		

continued

TABLE 12. Continued.

Taxon	Ned Wilson Lake			Oyster Lake		Upper Island Lake	
	1982	1983	Spring	1982	1983	1982	1983
Chironomidae - Chironomini (continued)							
Microtendipes sp. 2		0					
Pseudochironomus sp.				0	C		
Stictochironomus sp.				C	0		
Pagastiella sp.	R				R		
Phaenopsectra sp.			0				
Cladopelma sp.	R	R					
Chironomidae - Tanytarsini							
Tanytarsus sp.	R	0	R	C	C		
Paratanytarsus sp.		C		R	R	0	0
Corynocera sp.	C					0	
Lenziella sp.	0			0	R		
Chironomidae - Orthocladiinae							
Corynoneura sp.	C	C	C		0	C	
Cricotopus spp.					R		
Cricotopus Orthocladius						0	0
Cricotopus flavocinctus		0			R		
Cricotopus laricomalis			R				
Heterotrissocladius sp.	R	R					
Parametriocnemus sp.	0				R		
Psectrocladius sp. 1	0			R	R	C	
Thienemanniella sp.			R				
Synorthocladius sp.	0					0	0
Chironomidae - Diamesinae							
Pseudodiamesa sp.						0	
Pseudokiefferiella sp.		0					
Ceraptopogonidae							
Palpomyia sp.	0	R			R		

continued

TABLE 12. Continued.

Taxon	Ned Wilson Lake			Oyster Lake		Upper Island Lake	
	1982	1983	Spring	1982	1983	1982	1983
Syrphidae							
Eristalis sp.					R		
Lepidoptera							
Lepidoptera - all			R				
Coleoptera							
Acilus abbreviatus				R			
Hydrovatus sp.		0					
Rhantus sp.					R		R
Dytiscus sp.					R		
Agabus sp. 1					R		
Agabus sp. 2		R					
Agabus sp. 3		R					
Hydroporus sp. 1						0	C
Hydroporus sp. 2		R					
Ilybius sp.				R	R		
Deronectes griseostriatus	0	0		C	0	0	0
Helophorus sp.		R					
Hydracarina							
Lebertia sp.		0	R		R	C	C
Arrenurus sp.					0		
Hygrobates sp.						0	R
Piona sp.					R		
Limnesia sp.				0	0		
Cladocera							
Daphnia pulex		R			0		
Scapholeberis kingi		R					

continued

TABLE 12. Continued.

Taxon	Ned Wilson Lake			Oyster Lake		Upper Island Lake	
	1982	1983	Spring	1982	1983	1982	1983
Ostracoda							
Candona scapulosa		R	C				
Eucypris affinis hirsuta							0
Copepoda							
Diaptomus coloradensis		R			C		
Diaptomus arapahoensis							C
Diaptomus shoshone		0		C	0		
Macrocyclops albidus		0					
Amphipoda							
Hyalella azteca			0	C	C		
Gammarus lacustris			VC	0	C		
Nematoda							
Nematoda - all		0	R	R		C	
Oligochaeta							
Oligochaeta - all							R
Nias spp.	0		R	R	0		
Uncinais uncinata	0	R			R		
Lumbriculidae - all	C	C			R	0	VC
Immature Tubificidae WOCC	0		0				
Immature Tubificidae WCC	R						
Limnodrilus spiralis	0	R	R				
Enchytraeidae - all		R					
Hirudinea							
Nephelopsis obscura			R	0	R		
Glossiphonia complanata					R		
Helobdella stagnalis	0	C					0
Pelecypoda							
Pisidium sp.	C	0	C	C	0		

Oyster Lake--

Oyster Lake Ekman samples produced 35 taxa, dominated by the relatively large chironomid, Pseudochironomus sp., during 1982 and the small chironomid, Tanytarsus sp., during 1983 (Table 11). The shoreline invertebrate community, as in Ned Wilson Lake, was more diverse than the deeper sites yielding 48 taxa, 24 of which were unique to the shoreline. No single taxon predominated shoreline fauna (Table 12). Oyster Lake contained little benthic rock habitat; the bottom was mostly ooze and organic detritus. The shoreline community supported diverse assemblages of Ephemeroptera, Hemiptera, and Hydracarina; two species of amphipods, Gammarus lacustris and Hyalella azteca; and, two species of Hirudinea, Nephelopsis obscura and Glossiphonia complanata.

Upper Island Lake--

Upper Island Lake deep benthos was less diverse than either of the other study lakes. Quantitative sampling produced 15 taxa, while qualitative shoreline collection yielded 22. Six taxa were common to both areas. The low diversity may be a consequence of sampling only one deep site (UI4). The most abundant organisms in 1982 were the large chironomid, Chironomus sp. 2. An immature Tubificidae (without capilliform chaetae, probably Limnodrilus spiralis), was the most abundant organism during 1983. The shoreline community exhibited genera similar to Ned Wilson Lake (Table 12). Noticeably absent from all samples in Upper Island Lake were specimens of Pisidium sp. The lake floor is almost entirely rock/rubble; consequently, unsuitable habitat may be the limiting factor.

Lake Diversity--

Chironomidae and Oligochaeta appeared to be the most diverse and, depending upon the lake, the most abundant groups within the benthic invertebrate communities of the Flat Tops lakes (Table 11). Fifty-four macroinvertebrate taxa were encountered in quantitative (Ekman) samples from all lakes; eight were at the family level or higher, and all likely included more than one genus. Qualitative shoreline sampling collected 83 taxa; 42 of which were not found in the Ekman Samples. These data indicate that the shoreline-littoral zone contains the most diverse invertebrate communities within the study lakes. Alternatively, more rare taxa may be encountered when sampling shallow littoral areas because greater area and diversity of habitat can be sampled.

Species lists for each lake can be more than doubled by collection of qualitative samples and this practice should be continued. Additionally, a unit effort should be recorded for each sample collected; e.g. man hours dip netting and field or laboratory sorting, to assist future survey comparability. Times were not recorded during our surveys; however, between 10 and 16 man-hours were probably involved in each lake's qualitative sampling. This included three to four separate collection locations per lake (Figures 2, 3, and 4).

Additional data on Hester-Dendy and basket samples taken from Ned Wilson Lake and 10-rock samples taken from both Ned Wilson and Upper Island Lakes are provided in Appendix H. Of these sampling methods, only the 10-rock method consistently provided more than 100 organisms and the greatest diversity in taxa collected. However, the supplemental information provided by the 10-rock sampling method is minor and probably does not justify inclusion of this technique in future sampling programs.

Invertebrate results from a dip net sample, collected from a small spring approximately 100 m north of Ned Wilson Lake (August 18, 1982), are provided in Table 12 and Appendix I. The spring community near Ned Wilson Lake during 1982 was dominated by some typical stream invertebrates; e.g., caddisflies, *Limnephilus externus* and *Psychoronis costalis*; both amphipod species, as well as many other species located along the shoreline of Ned Wilson Lake. Surprisingly, some species (*N. obscura*, *G. lacustris* and *H. azteca*) found in the other two lakes, but not Ned Wilson Lake, were also encountered in the spring samples. The usefulness of this spring community to monitor changes associated with acidification is limited because it was dry in 1983. However, other springs and small streams of the Flat Tops may be very responsive to acid deposition because condensed pollutants released with early snowmelt will most strongly impact these communities. Water in the entire system may be quickly acidified during periods of runoff. Lake communities are more resilient to changes in pH because spring runoff may slowly dilute or contribute fractionally to the lake's total water volume.

Confidence in Data

Except as noted below, confidence in all taxa is considered high. Ephemeroptera were initially identified to genus using Edmunds et al. (1976). Confirmation was done by C. Evan Hornig, Moscow, Idaho, who identified *Callibaetis* sp. as probably *C. coloradensis* Banks. *Cloeon* sp. were also given a probable species, *C. ingens* McDunnough, because no other species have been described from Colorado. Confidence in generic identification for Ephemeroptera is high; species confidence is moderate. C. Evan Hornig also confirmed Odonata, non-chironomid Diptera, Coleoptera, and Hydracarina. *Enallagma* sp. were identified as probably *E. boreale* (Selys) using a few larvae and three adults (Needham et al. 1972); confidence is moderate. Corixids, *Arctocorisa sutilis* (Unler) and *Cenocorixa wileyae* (Hungerford), were identified by Russ Biggam using Hungerford (1948); confidence is high. *Gerris* sp. specimens were immature and difficult to distinguish; however, as no other genera of Gerridae have been reported in Colorado; confidence is moderate. Original generic identification for Hemiptera and Odonata utilized Usinger (1974). Generic keys of Pennak (1978) were used to identify Hydracarina.

Palpomyia sp. were identified from mature larvae originally classified as *Palpomyia* group (Johannsen 1937); confidence is moderate to high. Only one species of *Acilius* is known from Colorado (*A. abbreviatus* Aube), thus, confidence is moderate. Three species of *Agabus* and two species of *Hydroporus* were distinguished based on size, setation, and coloration of adults. All Coleoptera were keyed to genera using Usinger (1974). *Hydroporus* species may be lake specific (Tables 11 and 12). *Deronectes griseostriatus* were the only adults identified which associate with larvae originally called *Deronectes/Oreodytes*. Larvae can only be keyed to the genus complex and larvae encountered were assumed to be associated with adults. This assumption is weak, and confidence is moderate for larvae, but high for adults. *Rhantus* sp. identification was questionable; hence, confidence is low to moderate.

Trichoptera were originally keyed to genus with Wiggins (1977). David Ruiter, Denver, Colorado, confirmed Trichoptera genera identifications and noted *P. costalis* as the species of *Psychoronia* found in Ned Wilson Spring;

confidence is high. Mature Limnephilus larvae were identified as L. externus; confidence is high. Wiggins (1977) notes only one species of Psychoglypha, (P. subborealis) with specific characters that fit those collected. D. Ruiter notes that there are two species of Psychoglypha in Colorado with unassociated larvae; the confidence in species may therefore be only moderate. A few adults collected at Oyster Lake, not included in counts, were identified by D. Ruiter as Agrypnia deflata and Mystacides interjecta; no larvae were encountered.

Chironomidae were originally keyed to genus using Oliver et al. (1978) and Ferrington (1984). Confirmations were done by Dr. L. Ferrington, Kansas Biological Survey, University of Kansas (1982 collections) and James Pollard, UNLV, (1983 collections). Unless otherwise noted, confidence in Chironomidae identifications is high. Chironomus sp. 1 possesses ventral tubules; Chironomus sp. 2 had none. J. Pollard noted Dicrotendipes sp. probably were near D. neomodestus as described in New York by Simpson and Bode (1980); however, it has not been included as a species. Microtendipes sp. 2 was distinguished from sp. 1 in that sp. 2 has visibly anteriorly directed (L-shaped) anal tubules whereas sp. 1 has normal anal tubules. Additionally, the mentum of sp. 2 does not possess the small first laterals common to sp. 1. Tanytarsus appears to consist of more than one species; hence, Tanytarsus spp. may be more appropriate. Lenziella sp. (Ferrington 1984) keys only to Cladotanytarsus sp. in Oliver et al. (1978) and other keys. Some question exists in this genus, further examination is under way, but confidence can only be stated as moderate. Only one specimen of many Pseudokiefferiella sp. exhibited the difficult to distinguish annulations on the third segment of its antenna which places the organisms in Diamesinae (Ferrington 1984). Otherwise, all key well to Cricotopus laricomalis (Oliver et al. 1978, Hirvenoja 1973). One large C. laricomalis was found in Ned Wilson Spring in 1982, however, only small (early instars) larvae were collected in Ned Wilson Lake during 1983. These specimens will be further studied; currently, confidence in Pseudokiefferiella sp. is low. Our Psectrocladius sp. 2 does not fit Ferrington's (1984) key well, but it keys readily in Oliver et al. (1978). Ferrington's key identifies Psectrocladius sp. 2 as Limnophyes sp., hence, Psectrocladius sp. 2 confidence currently is low; additional study will be undertaken.

All zoobenthic crustaceans listed were identified using Edmondson (1959); confidence is high. However, one exception should be noted. Ostracods listed as Candona scapulosa possessed difficult characteristics; hence, our confidence in their identification is low. These will be sent to a specialist for confirmation. Other specimens were confirmed by Gene Wilde, UNLV. Amphipods were originally keyed using Holsinger (1972) and later confirmed in a discussion with J. Holsinger; confidence is high.

Specimens of Hirudinia were identified using Klemm (1972) and later confirmed by D. Klemm; confidence is high. Oligochaetes have also been offered to D. Klemm for confirmation. Wesley Kinney did original oligochaete identifications using keys of Brinkhurst and Jamieson (1971), Hiltunen and Klemm (1980) and Stimpson et al. (1982); confidence is moderate to high for all oligochaetes. One noteworthy observation should be mentioned. The immature Tubificidae without capilliform chaetae (W.O.C.C.) are likely immature Limnodrilus spiralis, and those with capilliform chaetae (W.C.C.) immatures of Ilyodrilus templetoni. Because reproductive organs are not developed in these individuals, they cannot be positively identified as species of either. No other mature tubificial species were isolated and therefore it is likely that they belong to no other species.

The pelecypoda, *Pisidium* sp., was confirmed by J. Landye, (Arizona Game and Fish) and W. Pratt, (UNLV); confidence is high. Additionally, W. Pratt notes that all specimens are likely from a single species.

Sensitivity to Acidification

Many macroinvertebrates of the class Insecta are generally classified as tolerant to acidic waters. Corixidae and Gerridae (Hemiptera), Coleoptera, Odonata and many Diptera are considered very tolerant of acidifying conditions in reviews by Roback (1974) and Singer (1982). Although various life stages and species within larger groups may be more sensitive than others, most adult stages are very tolerant. Tolerance results principally from the lack of filamentous gills or presence of gills which obtain oxygen at the surface and a heavy integument. The most sensitive insect order is probably *Ephemeroptera* (Harriman and Morrison 1980, Fiance 1978, Singer 1982). Decreased abundance of *Ephemerella funeralis* in an experimentally acidified stream section related strongly to lowered pH (Fiance 1978). Hendrey et al. (1980) also noted conspicuous mayfly absences in acidified lakes. Very few mayflys were obtained from the study lakes, (Appendices D, E, F and G); however, *Caenis* sp. and *Callibaetis coloradensis* occurred regularly in Oyster Lake samples (Tables 11 and 12). Loss of these taxa would suggest severe water quality changes. Coleoptera, Odonata and Corixidae (Hemiptera) often profilerate in acidified lakes and streams. The trend has usually been associated with fish population losses at pH values well below 6.0. Many species of the three groups can expand with losses of fish predators because they are top insect predators. Fish population changes probably would be noted prior to correlated insect population changes. Predatory larval and adult insects usually occurred in only qualitative samples; rarely were any found in Ekman dredges (Tables 11 and 12). Predatory insect population proliferation, in conjunction with or without fish losses, could imply acidifying conditions.

Chironomidae and Oligochaeta taxa constitute the majority of organisms collected in benthos of all study lakes (Table 11). Responses of larval chironomids to lake acidification has been suggested by various studies which compare acidified and neutral lake benthic communities. The use of chironomigenera as indicators may be possible in the near future; however, little detailed information is currently available. Wiederholm and Eriksson (1977) noted *Tanytarsus* spp. was often absent or reduced in density in acidified lakes. Beck's (1977) comprehensive review of chironomid literature does not isolate genera or species present in Flat Tops lakes which might be consistent indicators of changing pH conditions. Uutala (1981) noted an acidified lake (South Lake, New York) had lower chironomid densities, higher annual mean standing crop and higher annual production than a neutral lake (Deer Lake, New York). South Lake, with an alkalinity of 2-10 µg/l (Mitchell et al. 1981) and pH of 4.6-5.7, has undergone acidification and recent fishery losses (Pfeiffer and Festa 1980). Deer Lake has not undergone noted acidification (alkalinity 90-124 µg/l and pH 5.9-6.8; Mitchel 1981). Thirty-three chironomid genera were collected in nonacidified Deer Lake, with *Procladius* sp. dominant.

Acidified South Lake chironomid communities were dominated by Chironomus spp. and Phaenospectra spp. and contained 12 genera (Uutala 1981). Surveys by Wiederholm and Ericksson (1977) noted chironomid community differences associated with depth. Because sample depths within Uutala's (1981) study lakes were different, conclusions are somewhat weakened. In an Ontario survey, Collins et al. (1981), found minor benthic invertebrate abundance and biomass differences between acidic and neutral lakes. Collins et al. (1981) attributed the lack of impact to sediment buffering. Infauna, such as chironomids, oligochaetes and pelecypodas, inherently are somewhat protected by the medium they inhabit. Chironomids may also avoid pollutants by moving substantial distances through sediments (Wentsel et al. 1977). Chironomid mobility within sediments, sediment buffering capacity, and depth variability probably reduce infauna population alterations associated with lake acidification. Additionally, literature concerning chironomid responses to acidic waters is rare and the taxonomy is poorly known. The effects of increased H^+ ion concentrations and increased heavy metal content within waters and sediments of Flat Tops lakes, however, are likely to produce some community changes. Few specific taxon effects can be predicted; however, community alterations; e.g., changes in number of taxa, abundance, diversity, biomass (standing crop), and productivity can be expected (Wiederholm and Eriksson 1977, Uutala 1981). Future monitoring of macroinvertebrates should assess chironomid richness and density. Additionally, should one or more study lakes be impacted, chironomid community alterations, if documented, would prove invaluable because few prior and post acidification comparisons exist.

Benthic crustaceans, especially the amphipod, Gammarus lacustris, found in many lakes have been identified as indicator species. In high mountain lakes of Norway, G. lacustris is not found in waters with pH values less than 6.0 (Oakland 1980). Oakland (1980) also noted in his survey of 1000 lakes, that G. lacustris does not occur in lowland lakes with pH values less than 6.6. Few data are available concerning Hyalella azteca. However, it was considered to be a very sensitive species during an experimental stream channel acidification (Zischke et al. 1983). Although less affected at pH 6.0 (its drift increased drastically initially), density was significantly reduced at pH 5.0 during periods of acidification. Chronic effects of acidifying conditions on H. azteca populations may be substantial. Both amphipods were encountered in Ned Wilson and Oyster Lakes, and losses may be indicative of acidification.

In general, Oligochaeta are tolerant of many polluted conditions (Hart and Fuller 1981), but their sensitivity to acidified conditions may be substantial. Seasonal and depth variation in oligochaete community composition may produce very different results within and between lakes (Raddum 1980). Wiederholm and Eriksson (1977) and Raddum (1980) observed lower oligochaete densities and biomass in acidic lakes. One species, Limnodrilus hoffmeisteri, has been observed to dominate the benthic community of an acidic lake (Orciari and Hummon 1975). Limnodrilus spiralis, a species very similar to L. hoffmeisteri, occurs commonly in Ned Wilson and Upper Island Lakes and rarely in Oyster Lake (Table 11). Should L. spiralis populations become the dominant invertebrate in the lakes, changes in water quality could be a factor. Like chironomids, however, many factors contribute to sediment-inhabiting invertebrate population changes. Therefore, observed changes within oligochaete communities by themselves may not be well defined indicators of water quality changes. Future alterations may be quantifiable because current data are available.

The effects of acidification on leech (Hirudinea) communities common to the study lakes are potentially significant. Nephelopsis obscura individuals have been observed in waters with pH values between 6.3 and 10.0; Glossiphonia complanata in waters exhibiting pH values only as low as 5.5.; and Helobdella stagnalis in very polluted waters and waters with pH values down to 5.0 and 4.0 (Sawyer 1974). Although community changes would not be expected until mean water pH values approximate 6.0, pulse events; such as, snowmelt, could precipitate temporary alterations before the entire lake acidifies permanently. The only difficulty encountered in sampling Hirudinea is that, except for H. stagnalis, those present inhabit the littoral vegetated zone (Sawyer 1974). Absence or presence may be difficult to verify using qualitative sampling methods. In general, losses of N. obscura and G. complanata (both sampled only from Oyster Lake) or proliferation of H. stagnalis (sampled from Ned Wilson and Upper Island Lakes) could indicate acidifying conditions.

Losses or absences of shaeriid molluscs from acidified lakes has been documented (Singer 1981). Most species of Pisidium are not found in waters with pH values less than 6.0 (Oakland 1980). In acidified lakes, molluscs and gastropods are characteristically reduced in density or absent (Wiederholm and Eriksson 1977, Singer 1982). Molluscs, being part of the sediment infauna, may be subject to less perturbation due to changes in water quality than epifauna. Aside from direct toxicity, shell dissolution and reduced $CaCO_3$ available for shell secretion in low alkalinity-acidic waters may be chronically harmful. Singer (1981) noted that shells of Anodonta grandis (Unionidae) taken from acidified lakes were "half as thick as any of the other shells (from neutral lakes), heavily eroded, overlain with organic material and crumbly. . .." Although not considered in the present study, future investigations may be able to utilize this source of information. See Rhoads and Lutz (1981) for further shell study details. Pisidium sp. were not collected from Upper Island Lake, hence, usefulness as an indicator of problems in Upper Island Lake is null. In both Ned Wilson Lake and Oyster Lake, Pisidium sp. is abundant to very common (Tables 11 and 12). Population reductions or losses would be strongly indicative of water quality alterations.

Macroinvertebrate Community Indices

At one time, the concept of indicator species, groups, or parameters had great expectations as a basic tool to monitor changing water quality. The goal of many biological monitoring programs has been to isolate and record changes in indicator species or taxa. Very often, taxonomic groups as high as the family level are used to specify pollutant tolerances (Roback 1974, Hall et al. 1980, Eilers et al. 1984). Species and population sensitivity ranges, interactions with varying community assemblages, and differing quality of waters result in a multitude of organism responses. Additionally, specific responses of vertebrates, macroinvertebrates, zooplankton, periphyton, and phytoplankton to acidifying waters are relatively unknown and, when available, are often contradictory. Presence or absence of indicator species may be due to: 1) water chemistry, 2) availability of a colonization species pool, 3) season of collection, 4) stream flow or lake stratification regimes and 5) chance (Roback 1974). Hence, actions based upon alterations within community indicator species or assemblages may be precarious. Biological data used as baseline information, however, are invaluable. Specific indices can be useful when referenced along with available community structure and function information.

Oyster Lake contains the most dense (>14000 individuals/m^2) and most species rich (18 taxa per sample) benthic invertebrate populations (quantitative data, Table 13). Diversity in Oyster Lake is also higher than the other lakes at 2.92 and 2.85 for 1982 and 1983, respectively (Table 13). Except for NW3, evenness and dominance is usually similar between sites and years for each lake (Table 13). Ned Wilson site 3 is unique because it is very shallow and contains some gravel and rock debris. Significant differences ($\alpha<0.05$, ANOVA) exist in the number of taxa and number of organisms collected between 1982 and 1983 from Ned Wilson Lake, but no differences are noted between years in Oyster Lake (Table 13). Site differences from Ned Wilson Lake (1983 survey) appear minimal. Only site 3 (NW3) contained significantly fewer taxa than site 4 (NW4). No station by itself was different from the pooled data for 1983 for any index tested (Table 13). Indices of diversity, evenness and dominance appear less variable than the more direct indices (number of organisms and number of taxa sampled). The evidence suggests that one station alone or more than one station (pooled) would provide similar results.

Sensitivity of Indices to Acidification

Typically, acidification of the environment results in: 1) reduced number of taxa or richness (Hendrey et al. 1980, Arnold et al. 1981, Raddum and Saether 1981, Zischke et al. 1983); 2) reduced density or abundance (Sutcliffe and Carrick 1973,, Wiederholm and Eriksson 1977, Fiance 1978, Friberg et al. 1980, Burton et al. 1982, Zischke et al. 1983); 3) reduced diversity and conversely increased dominance (Herricks and Cairns 1976, Tomkiewicz and Dunson 1977, Wiederholm and Eriksson 1977, Friberg et al. 1980, Hall et al. 1980, Vangenechten 1983, Zischke et al. 1983); and 4) usually, but not always, a reduction in standing crop, biomass, and productivity (Leivestad et al. 1976, Tomkiewicz and Dunson 1977, Collins et al. 1981, Uutala 1981, Danell and Andersson 1982). The alteration in one or more index may suggest changes in Flat Tops lakes' water quality. Evidently, sampling from only one deep site is sufficient to enumerate benthic invertebrate community structure from detritus/ooze bottom lakes. Annual differences between the number of taxa and organisms collected, however, suggest seasonal or annual differences can be substantial in Ned Wilson Lake. Unless natural variation in invertebrate populations is understood, meaningful conclusions cannot be drawn from even drastic alterations. Most indices vary seasonally and yearly in response to natural cues and species' circadian or innate rhythems; e.g., spring pupal emergence, reproduction and eclosion (egg hatching). A series of benthic surveys during ice free periods for a minimum of one year could elucidate natural seasonal variation. Annual variation could be ascertained in a few years of samplings. Although neither variation can be entirely quantified, additional surveys can aid management decisions when community alterations are observed.

TABLE 13. MEAN VALUES AND RESULTS OF SELECTED ANOVA AND STUDENT NEWMAN KUELS TEST OF RANGES (SNK) FOR FLAT TOPS LAKES MACROINVETEBRATE COMMUNITY PARAMETERS. ANOVA designated differennces are isolated by SNK tests; significant differences noted as $\alpha = 0.05$; parentheses delineate test limits. Mean density estimates ($\#/m^2$) can be calculated by multiplying counts (mean number collected) by 43.1.

Parameter		Ned Wilson Lake						Oyster Lake		Upper Island Lake	
		1982 Sites 1, 2, 3, 4	1983 Sites 1, 2, 3, 4	1983 Site 1	1983 Site 2	1983 Site 3	1983 Site 4	1982 Sites 1, 2	1983 Sites 1, 2	1982 Site 4	1983 Site 4
Number of Organisms Collected	$\bar{X}$	139	102	93	94	83	138	317	334	240	175
	SNK		(———	———	———	———	———)				
	SNK	(———	———)					(———	———)	(———	———)[1]
Number of Taxa (Richness)	$\bar{X}$	10	13	13	13	10	15	18	18	10	7
	SNK		(——— (———	——— ———	——— ———	——— - - -	 ———)				
	SNK	(———	———)					(———	———)	(———	———)
Shannon-Weiner Diversity	$\bar{X}$	2.5024	2.622	2.831	2.827	2.003	2.829	2.9208	2.8466	2.2942	1.9605
	SNK		(———	———	———	———	———)				
Evenness	$\bar{X}$	0.7497	0.7177	0.7643	0.7668	0.6154	0.7242	0.7013	0.6839	0.6817	0.7180
	SNK		(———	———	———	———	———)				
Dominance	$\bar{X}$	0.7589	0.7592	0.8036	0.8149	0.6145	0.8042	0.7858	0.7778	0.6987	0.6857
	SNK		(———	———	———	———	———)				

Note 1. ANOVA not usable due to lack of variance homogeneity; Kruskell-Wallace Test results.

SALAMANDERS

Distributions and Sensitivity to Acidification

Only Oyster Lake contained a population of salamanders, Ambystoma tigrinum. Population surveys or tissue analyses were not conducted. An attempt to characterize the Oyster Lake A. tigrinum population size may be warranted. Additionally, heavy metal analysis of tissues could help expand the data base for the salamander which is the only vertebrate inhabiting waters of Oyster Lake.

Ambystoma tigrinum is one of the most widely distributed salamanders occurring in the United States (Sexton and Bizer 1978), and the only salamander on the western slopes of the Colorado Rockies (J. Harte 1984, personal communication). Ambystoma tigrinum is normally the largest aquatic vertebrate present in high altitude ponds devoid of fish. The introduction of fish results in elimination of viable populations (Sexton and Bizer 1978). Ambystoma tigrinum populations in Oyster Lake can be visibly censused. Its appropriateness as an indicator species in mountain regions of the west may be substantial. Salamanders breed in temporary, as well as permanent, pools that develop from spring snowmelt (Pough 1976), and pH sensitive early life stages are potentially subjected to a concentrate of acidic runoff. High egg mortality and embryonic abnormalities have been observed in Ambystoma maculatum temporary acidic ponds and laboratory experiments (Pough 1976, Pough and Wilson 1977). Certain other species of Ambystoma appear more tolerant (Pough 1976). No information exists relative to A. tigrinum responses to acidifying conditions. Clearly, more data would be required prior to utilization of A. tigrinum as an indicator species.

FISH

Distributions

Population demography and reproductive extent of salmonids inhabiting Ned Wilson and Upper Island Lakes are not known. Brook trout (Salvalinus fontinalis) occur in Ned Wilson Lake; rainbow trout (Salmo gairdneri), cutthroat trout (Salmo clarki) and hybrids occur in Upper Island Lake. No fish were observed in Oyster Lake. All salmonids presumably were stocked. Whether natural reproduction is occurring could not be determined.

Sensitivity to Acidification

If natural reproduction occurs in these lakes, the potential for acid-induced population changes would be significant. Gametogenesis, eggs, larvae, and fry of salmonids have been shown to be very sensitive to effects of acidification (Kwain 1975, Schofield 1976, Chakoumakos et al. 1979, Yan et al. 1979, Sevaldrud et al. 1980, Haines 1981). Experimental and actual field data suggest reproduction of brook, rainbow and cutthroat trout is chronically impacted at pH values between 5.5 and 6.5 trout (McKim and Benoit 1971, Kwain 1975, Menendez 1976, Sevaldrud et al. 1980). Mature fish often suffer acute effects of acidification only after pH values are reduced below 5.5 (McKim and Benoit 1971, Huckabee et al. 1975, Falk and Dunson 1976, Schofield 1976, Haines

1981, Baker and Schofield 1982). Consequently, early signs of acidification probably would not be discerned by changes in an artificially maintained salmonid population. A reproducing population would show effects of early acidification by changing population age and growth structure. Determination of fish population structure in all study lakes containing reproducing populations would be a critical component of a long-term monitoring program. Because variation in annual recruitment may be substantial, two to five years of data would be vital.

Tissue Metal Concentrations and Metal Toxicity

Mean metal concentrations of whole fish and gills from brook and cutthroat trout from Ned Wilson and Upper Island Lakes, respectively, are presented in Table 14. Appendix J contains raw data. Metal concentrations in brook trout taken from Ned Wilson Lake during 1982 were typically very low. Zinc (Zn) concentrations in whole bodies of brook trout showed only a slight increase during 1983, whereas Cu and Ni levels were elevated several fold. The 1983 data, however, were derived from analysis of only two trout, whereas six trout collected in 1982 were digested and analyzed. No trout were collected from Upper Island Lake for tissue analyses during 1982, but two cutthroats were collected and homogenized for whole body analyses during 1983. Concentrations of Cu, Ni and Zn were approximately an order of magnitude higher in these specimens than the highest values observed in Ned Wilson Lake brook trout. It must be emphasized that the sample size was very small (2 specimens) and these data must be interpreted with this in mind. Additional sampling and analyses of Upper Island Lake cutthroat trout of various age classes should be conducted to further examine metal concentrations in fish tissues. Very little literature is available comparing tissue metal concentrations of fish from acidic and neutral lakes. Increased mobilization of mercury (Hg), aluminum (Al), lead (Pb), iron (Fe), manganese (Mn), nickel (Ni), cobalt (Co), magnesium (Mg), zinc (Zn), copper (Cu) and other metals have been associated with acidifying conditions and fish toxicity (Freeman and Everhart 1971, McKim and Benoit 1971, Huckabee et al. 1975, Merlini and Pozzi 1977, Norton 1977, Chakoumakos et al. 1975, Yan et al. 1979, Jackson et al. 1980, Baker and Schofield 1982). Although direct toxicity from metals can occur, concentrations currently in these lakes' water would have to increase many times to reach toxic concentrations. Tissue metal concentrations, however, may be increased in conjunction with further acid deposition and metal mobilization. Of particular concern in the Flat Tops may be increasing concentrations of aluminum from the oil shale industry. Freeman and Everhart (1971) note that the recovery process releases aluminum from certain types of oil shale (Dawsonite). Increases in tissue metal concentrations may be indicative of altered water quality and well in advance of whole lake acidification. Future study should entail tissue metal determinations.

METALS IN SEDIMENTS

Metal Concentrations

Mean metal concentrations within Flat Tops study lakes' sediments are provided in Table 15. Raw data are available in Appendix K. Aluminum is the most abundant metal in sediments, with concentrations between two and three

TABLE 14. DIGESTED TISSUE METAL CONCENTRATIONS FROM NED WILSON LAKE (*S. fontinalis*) AND UPPER ISLAND LAKE (*S. clarki*) FISH COLLECTED DURING 1982 and 1983. Standard deviations are noted in parentheses below each mean.

Lake/Date	Sample	Element (mg/kg)														
		As	Se	Fe	Mn	Pb	Be	Cd	Cr	Zn	Ni	Cu	Ag	Al	Hg	Mg
Ned Wilson 07-06-82	*S. fontinalis* (Whole)	<0.08 (0)	3.3 (0.24)	N/A	N/A	1.4 (0.50)	0.3 (0.15)	0.9 (0.27)	2.7 (1.12)	116 (29.6)	1.9 (1.88)	5.2 (0.47)	<0.001 (0)	N/A	N/A	N/A
Ned Wilson 08-25-83	*S. fontinalis* (Whole)	<0.05 (0)	0.8 (0)	<5 (0)	<2.5 (0)	44 (0.7)	N/A	0.7 (0)	3.5 (0.7)	174 (0.7)	94 (2.1)	142 (1.4)	<2.5 (0)	83 (3.5)	<38 (0)	<25 (0)
	S. fontinalis (Gills)	<0.08	<0.08	<5	<2.5	19		2.7	<3	102	<8	6	<2.5	383	-	<25
Upper Island 08-27-83	*S. clarki* (Whole)	<0.05 (0)	0.3 (0.19)	<5 (0)	<2.5 (0)	89 (4.2)	N/A	0.6 (0.01)	3.5 (0.7)	978 (18.4)	11.82 (24.7)	1078 (25.5)	<2.5) 0	<50 (0)	<38 (0)	<25 0
	S. clarki (Gills)	<0.05	1.6	<5	<5	3		0.8	<3	65	<3	11	<2.5	<50	-	<25

TABLE 15. DIGESTED TOTAL METAL CONCENTRATIONS FROM SEDIMENTS COLLECTED DURING 1982 AND 1983 FLAT TOPS LAKE SURVEYS. Concentrations are mg/kg except Al (g/kg). Standard deviations are noted in parentheses below each mean.

		Element (mg/kg)												
Lake/Date	Sample	As	Se	Fe	Mn	Pb	Cd	Cr	Zn	Ni	Cu	Ag	Al[1]	Mg
Ned Wilson 8-25-83	Sediments (NW4)	0.016 (0.001)	<0.025 (0)	<5 (0)	<25 (0)	25 (3.5)	0.4 (0.02)	49 (9.6)	75 (8.1)	38 (5.0)	20 (3.2)	<2.5 (0)	24 (2.6)	<25 (0)
Oyster 8-18-82	Sediments (0.6)	0.009 (0)	<0.025 (0)	<5 (0)	<2.5 (0)	32 (7.1)	0.5 (0.15)	35 (1.4)	56 (4.2)	22 (0.7)	17 (2.8)	<2.5 (0)	18 (0.5)	<25 (0)
Upper Island 8-27-83	Sediments (UI4)	0.020 (0.007)	<0.025 (0)	<5 (0)	<2.5 (0)	35 (15.0)	0.2 (0.05)	31 (5.0)	87 (15.8)	28 (3.5)	20 (0)	3 (1.4)	30 (5.9)	<25 (0)

Note 1. Concentrations of Al ar g/kg

percent (sediment weight) occurring in all lakes (Table 15). This is not surprising, however, because aluminum averages near six percent in surrounding watershed soil (J. Turk unpublished data). Concentrations of other metals in lake sediments are well within the range expected for unimpacted Western U.S. waters.

Acidification Effects

The importance of lake sediments as a sink for heavy metals in the water column is well known (Oschwald 1972, Wentsel et al. 1977). However, increases in aquatic metal concentrations have been related to increased leaching from soil and benthic sediments as a result of acid deposition and runoff (Beamish 1975, Malmer 1976, Wright and Gjessing 1976, Schofield 1976, Norton 1977, Cronan and Schofield 1979, Jackson et al. 1980, Schindler et al. 1980). The potential for metal concentration changes due to acidification is significant. Certain metal (Hg, Al, Mn, Zn, and Fe) have been shown to decrease in sediment concentration or rate of incorporation into sediments when water pH is reduced (Jackson et al. 1980, Schindler et al. 1980). Other elements (Ba, Se, Cs, and V) either increase concentrations within sediments or are not affected by water pH changes (Schindler et al. 1980). Specific changes in solubility, predominant species, receptor sites, sediment and water quality, and degree of acidification affect metal sources, sinks, pathways and rates of transfer. Hence, each metal surveyed from Flat Tops lake sediment will likely behave differently from other metals. Aluminum, for instance, is known to increase in solubility as pH deviates either upwards or downwards from pH 5.5 (Freeman and Everhart 1971). Consequences of increased concentrations of metals in the water column (due to enhanced soil leaching and industry inputs), associated with acidification, could have a variety of effects on metal concentrations in sediments. These effects can not be predicted by the authors. Future monitoring of sediment metal chemistry will be valuable. Currently, its only value is as baseline data because alterations in metal concentrations in the sediment cannot be accurately foretold. One to three years of baseline data should delineate the natural variation, which is expected to be low.

WATER QUALITY

Lake Characteristics

In 1983, temperature structure in both Ned Wilson and Oyster Lakes was isothermic due to the shallow depth of these lakes (Figure 5). Dissolved oxygen concentrations in these lakes were below saturation and exhibited a clinograde oxygen profile. Upper Island Lake was deeper and thermal stratification was well developed with a thermocline depth between 8 and 10 m. Dissolved oxygen concentrations in Upper Island Lake exhibited a positive heterograde oxygen profile which was associated with thermal stratification. Dissolved oxygen concentrations were near saturation or super saturated in the epilimnion and metalimnion; however, oxygen depletion had occurred in the hypolimnion and dissolved oxygen concentrations were below saturation. Temperature structure and oxygen profiles were similar in 1982 (Baldigo et al. 1983).

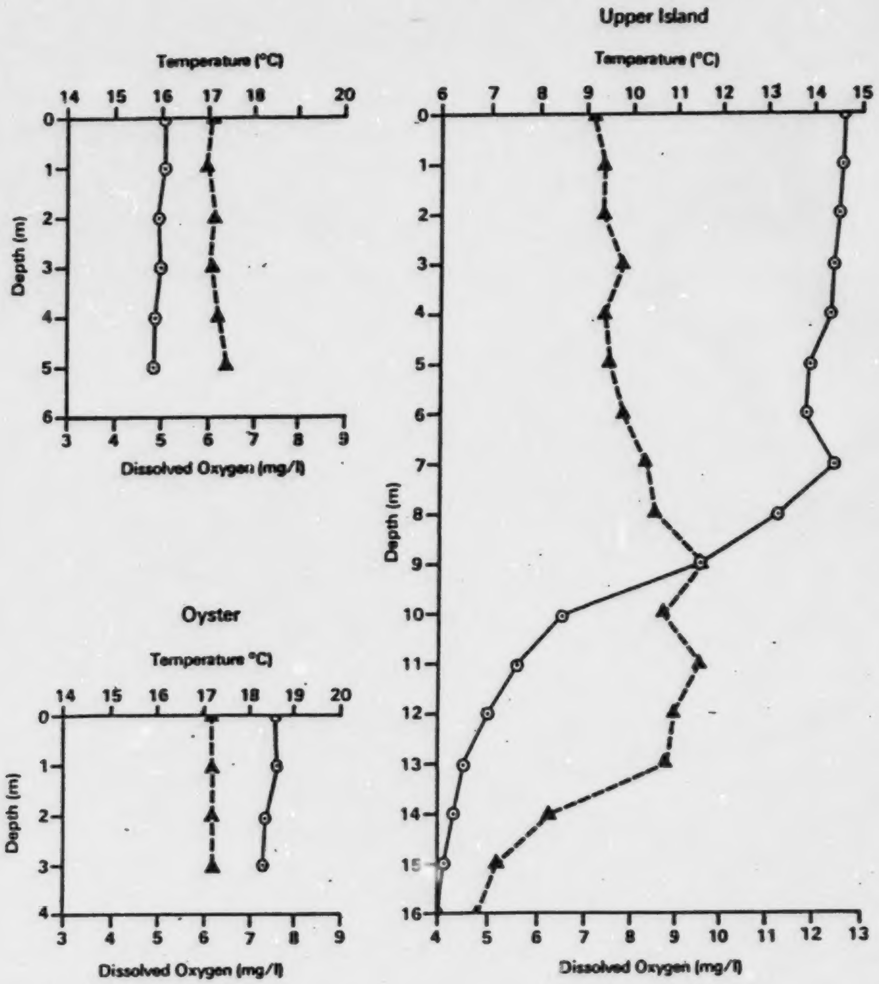

Figure 5. Temperature (⊙———⊙) and dissolved oxygen (▲———▲) depth profiles from Flat Tops lakes sampled August 1983. Each data point represents mean values from all sites at similar depths within a given lake.

Physical and chemical parameters measured in the Flat Tops lakes (Table 16) were typical of lakes in this region of Colorado (Harte et al. 1984, Turk and Adams 1982, Dodson 1982). Ion concentrations (conductivity), alkalinity, sulfate and chloride concentrations were lowest in Ned Wilson Lake (Table 16). These parameters were only slightly higher in Oyster Lake but were approximately two times higher in Upper Island Lake (Table 16). Metal concentrations were low and were all well below toxic concentration (Table 17). Mean pH values for Ned Wilson, Oyster and Upper Island Lakes were 6.8, 8.2 and 6.3, respectively (Table 16). Measurements of pH with the instruments used in this survey were questionable because of the low ionic strength of the water (personal communication Hydrolab Corporation, Gallaway et al. 1982). However, pH values were

TABLE 16. NED WILSON LAKE, UPPER ISLAND LAKE, AND OYSTER LAKE WATER CHEMISTRY, EXCLUDING METALS. Data were generated from composite samples collected during August, 1983.

Parameter	Ned Wilson		Oyster		Upper Island	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Temperature^2 (°C)	16.1	0.4	18.5	0.3	14.6	0.2
Dissolved Oxygen^2 (mg/l)	6.1	0.3	6.2	0.1	7.3	0.6
pH^2 (units)	6.8	0.3	8.2	0.1	6.3	0.2
Conductivity^2 (μmho/cm)	64.2	8.3	112.5	4.6	68.9	3.2
Alkalinity (μeq/l)	78.2	11.4	216.0	8.5	96.0	3.3
Color (NTU)	0	0	0	0	0	0
TOC (mg/l)	2.61	1.30	5.07	0.81	2.32	0.79
DOC (mg/l)	2.86	1.39	0.32^1	0.28	0.67^1	0.89
Sulfate (μg/l)	522.8	38.2	777.0	40.8	559.6	38.5
Chloride (μg/l)	123.8	20.0	178.7	16.7	139.2	46.8
Fluoride (μg/l)	<60.0	0	<60.0	0	<60.0	0
Total Phosphorus (μg/l)	15.9	0.3	18.2	0.4	13.5	1.2
Nitrate (μg/l)	<164	0	<164	0	<164	0
Nitrite (μg/l)	<7.2	0	<7.2	0	<7.2	0
Ammonia (μg/l)	29.5	3.3	46.5	6.4	29.5	15.8
Chlorophyll *a*^{3} (μg/l)	1.3	0.1	1.2	0.1	1.1	0.2

Note 1. Resultant means and standard deviations incorporate detection limit data; actual mean is likely less than presented.

Note 2. These data were generated from 0, 1, and 2 meter depth samples; i.e., surface readings only.

Note 3. Strickland and Parsons (1972) uncorrected chlorophyll *a*; phaeophytin correction results in unreliable negative values.

within reported ranges for these lakes (USGS unpublished data). Nutrient concentrations were relatively high (Wetzel 1975) with total phosphorus concentrations greater than 13 μg/l and ammonia concentrations greater than 29 μg/l in all study lakes (Table 16). Although nutrient concentrations were relatively high, phytoplankton biomass was low in all lakes; chlorophyll *a* concentrations normally were less than 1.4 μg/l. Organic carbon concentrations were also low (Wetzel 1975) and did not contribute to color in these lakes (Table 16).

Acidification Effects

Various physical and chemical water quality parameters have been shown to deviate in neutral lakes and streams upon acidification. Most of the chemistry trends related to acidification presented in this report are from the experimental acidification of Lake 223 in the Canadian Shield area (Schindler and Turner 1982, Schindler et al. 1980).

Obviously, increased acid inputs result in reduced pH and alkalinity and an increase in ionic concentrations. Change in lake alkalinity is the best

TABLE 17. MEAN TOTAL METAL CONCENTRATIONS FROM WATER SAMPLES COLLECTED DURING 1983 FLAT TOPS LAKES SURVEYS. Less than values are included in calculations whenn other data are available, hence some means are likely over estimated. Standard deviations are noted in parentheses below each mean.

	Element (µg/l)													
Lake/Date	Al	Cd	Zn	Cu	Cr	Pb	Se	As	Ca	Ni	Fe	Mn	Mg	Ag
Ned Wilson 8-25-83	102 (19.3)	0.4 (0.25)	55 (14.3)	10 (3.6)	<50 (0)	6 (3.2)	<0.5 (0)	1.0 (0)	1401 (374)	<50 (0)	105 (18.8)	<50 (0)	<500 (0)	<50 (0)
Oyster 8-24-83	102 (23.5)	0.3 (0.10)	52 (7.6)	10 (4.2)	<50 (0)	5 (1.7)	<0.5 (0)	1.3 (0.47)	1525 (182)	50 (1.2)	103 (5.3)	<50 (0)	946 (200)	<50 (0) (0)
Upper Island 8-[illegible]-83	107 (16.8)	0.4 (0.48)	67 (22.3)	14 (4.5)	<50 (0)	9 (2.8)	<0.5 (0)	1.0 (0)	2667 (52)	55 (16.7)	115 (52.5)	<50 (0)	<500 (0)	<50 (0)

indication of early acidification. As alkalinity is reduced in response to acid inputs, a point is reached where the neutralizing capacity is exceeded. As a consequence, pH can rapidly decrease and significant, often irreversible, chemical and biological perturbations occur.

Therefore, acidification can reduce color by reducing total and dissolved organics and, thus increase transparency and Secchi depth (Malley et al. 1982, Schindler and Turner 1982, Yan 1983). However, these parameters in the Flat Tops lakes would be altered very little as all lakes are oligotrophic and color was not detected. The Secchi disc was visible on the bottom at all lake sites except one. Upper Island site 4 (UI4) had a Secchi depth of 9.5 m. Only at UI4 could changes in transparency be associated with acidification.

Acidification effects on nitrogen cycling are complex. Reductions in pH may inhibit bacterial decomposition and alter nitrification. Consequently, an increase in ammonia and decrease in nitrite and nitrate could occur. Alternatively, urban areas contribute nitrates from auto emissions to precipitation. Lewis and Grant (1980) determined nitrate contamination within precipitation in Colorado was responsible for rainfall pH reductions. Therefore, increased levels of nitrate could occur in the Flat Tops lakes with little or no alteration in nitrite or ammonia. Nitrate monitoring would appear to be most informative of the nitrogen species and is recommended for future surveys. Because all nitrate data are below detection, a technique which provides lower detection limits is recommended. Ammonia was the principal nitrogen species in these lakes and should also be monitored.

Effects of lake acidification on phosphorus cycling appears minimal. Schindler and Turner (1982) found no correlation between lake acidification and total and dissolved phosphorus. Estimates of total phosphorus in our study lakes, however, appear high and further monitoring could provide valuable information.

Changes in chlorophyll a concentrations due to acidification within the study lakes would appear to be of little consequence. In general, chlorophyll a decreases are anticipated with lake acidification and oligotrophication (Almer et al. 1974, Grahn et al. 1974). Schindler and Turner (1982) reported increased chlorophyll a content with pH reduction. They related the unexpected increase to a phytoplankton bloom associated with greater water transparency. Perturbations due to a pH change would not be expected because the study lakes exhibit very clear water and chlorophyll a concentrations are naturally low.

The components of water chemistry of utmost concern are heavy metals which may reach toxic concentrations in lakes undergoing acidification. Acidification increases metal leaching from soils and lake sediments. Although conflicting data have been reported, trends can be generalized. Aluminum, Ca, Co, Na, Fe, Mn, Ag, Cr, Zn, Pb, Cu, Cd, Ni and other metals have been reported to increase in acidified stream and lake waters (Beamish 1976, Wright and Gjessing 1976, Beamish and Van Loon 1977, Norton 1977, Cronan and Schofield 1979, Schindler et al. 1980, Schofield and Trojnar 1980, Schindler and Turner 1982). Metal solubility varies with specific water quality and the degree to which acidification effects solubility varies substantially between elements. Aluminum, Hg, and Fe are probably the most difficult metals to predict alterations caused by acidification. Aluminum, for example, increases solubility below and above pH 5.5. Mercury becomes less soluble as water pH is reduced; however, transferal rates to sediment are reduced. Metal concentrations most likely to respond to pH changes are Al, Mn, Zn, Fe and Ni. Iron (Fe), Al, Mn and Zn are released from sediments and increase solubility with reduced pH (Schindler et al. 1980). Norton (1977) identified Al, Fe, Mn and Ni as metals most susceptable to increased soil leaching during acidic runoffs. Additionally, aluminum is highly concentrated in Flat Tops lakes sediments and surrounding watershed soils. Water concentrations of these metals, especially aluminum, should be monitored frequently to ensure toxic levels are not achieved should acid deposition rates increase.

MONITORING REQUIREMENTS

Monitoring Alternatives

A monitoring program designed to detect and quantify the extent of acid-related disturbances to Flat Tops lakes should incorporate biological and chemical components on an integrated basis. Biological monitoring is essential to identify the nature and magnitude of changes to aquatic ecosystems, and chemical monitoring is necessary to identify reasons for the changes. Biological monitoring is particularly useful for detecting episodic or infrequent acidification impacts which are not detected with chemical monitoring. Unless continuous automated samples or monitors are employed, chemical sampling would not register temporal water quality perturbations occurring in remote areas. Biological monitoring is expensive in terms of manpower requirements, and the results are frequently difficult to interpret because of the high natural variability in communities, spatially, seasonally and annually. Owing to this high variability, intensive surveys are required to adequately characterize the distribution, abundance and seasonal patterns of the various lake community assemblages. Because the biota respond to all external and internal factors influencing the ecosystem, several years of baseline data may be required to document the range of natural conditions (for example, community standing crop, species composition and relative abundance). Chemical monitoring requirements are typically less manpower intensive than biomonitoring requirements, but required frequencies of measurement are generally greater because of the high degree of temporal variability in some water quality parameters. For example, in poorly buffered lakes, idle periods of photosynthetic activity and respiration may cause pH changes of several units. Similarly, seasonal changes in many water quality parameters (for example, dissolved oxygen, macro and micro nutrients) occur in response to natural temperature regimens, increases or decreases in level of biological activity or pulses associated with periods of snowmelt or rainstorm events.

Threat of Acid Deposition

The threat of acid deposition to the Flat Tops Wilderness Area is apparently real. Although no precipitation data are available from the Flat Tops, monitoring stations on the western slopes of the Rockies have recorded precipitation pH values between 3.0 and 4.0 (Lewis and Grant 1980, USDA Forest Service 1981, Harte et al. 1984). Average pH of summer and winter precipitation events averaged 4.81 and 4.79, respectively, between mid 1980 and mid 1983 (Harte et al. 1984). Large areas in the Northeast and Europe where lake acidification is occurring receive precipitation with pH averaging between 4.0 and 4.4. Natural rainfall pH averages approximately 5.65. The Flat Tops are clearly receiving precipitation less acidic than areas where severe impact has been documented, but more acidic than is expected naturally.

The underlying geology of the Flat Tops, in many areas, is unreactive (low carbonate content) (USDA Forest Service 1981) and, as a result, surface waters are poorly protected against acid perturbation (Norton et al. 1982, Omernik and Powers 1982). Study lake waters, with alkalinity ranging from 70 to 200 µeq/l, can be considered moderately to highly sensitive to acid deposition (Omernik and Powers 1982).

Effects of Acidification

Vertebrate and invertebrate population reductions that can be attributed to complex changes in water quality may be due both to direct and indirect effects associated with acidification. Toxic effects of high H^+ ion concentrations result directly from physiological stress. Osmo-regulation is affected by sodium, calcium, and chlorine imbalances; oxygen utilization is affected by respiratory obstruction; and physiological activities stressed by internal fluids pH changes (Leivestad and Muniz 1976, Ultsch 1978, Havas 1981 and Havas and Hutchinson 1982). Leaching of heavy metals from soil and aquatic sediments can reach toxic concentrations (Schofield 1976, Beamish and Van Loon 1977, Raddum 1980, and Schofield and Trojnar 1980). Direct effects of increases in both H^+ ion and heavy metals concentrations may invoke chronic responses. Reproduction inhibition or failure has been a well documented chronic effect (Beamish 1976, Fiance 1978, Carrick 1979, and Lee and Gerking 1980). Indirect effects result from predator population and food base changes. Loss of predator populations can result in increased numbers and larger body sizes of former prey species as well as proliferation of former competitors (Eriksson et al. 1979, Friberg et al. 1980, Hendrey et al. 1980, Henrikson 1980, and Singer 1982). Last, and perhaps most importantly, are indirect effects of a changing food base. Nutrient cycling is drastically inhibited when pH levels drop sufficiently to cause microbial decomposer disfunction (Hendrey et al. 1980, Schindler et al. 1980). Fungi, filamentous algae, and occasionally *Sphagnum* replace bacterial decomposers (Grahn et al. 1974, Grahn 1977, Hendrey et al. 1980, and Schindler and Turner 1982). Reorganization of the food pyramid base (primary producers) and associated primary and secondary consumers ensues. Alterations of the macroinvertebrate community functional groups (consumer groups) during acidification have been documented (Sutcliffe and Carrik 1973, Friberg et al. 1980, Hall et al. 1980, and Zischke 1983). Although not analyzed in the present study, consideration of invertebrate functional classes in the future may signal changing lake chemistry.

Biological Monitoring

Each community or group investigated by this report possess positive and negative aspects that reflect their proficiency as monitoring standards.

The phytoplankton community has been shown to respond quickly (short-term) to experimental pH reductions. Long-term changes in community structure have been documented under natural lake acidifications. Consequently, their value as indicators of past acid pulses and permanent water quality (pH) alteration is known. Most data, however, suggest community changes occur only after water pH falls below 5.5. Additionally, seasonal succession occurs quickly within plankton assemblages and masks water quality induced perturbations. Because species taxonomic differences and seasonal variation can be significant, it is suggested that higher taxonomic levels from samples taken during similar periods each year be routinely compared. This practice will help alleviate taxonomic inadequacies and provide sufficient data to identify currently recognized community changes.

The zooplankton communities of Flat Tops study lakes were somewhat unique and characterized by very low diversity. Only two species of *Daphnia* were collected. The species were *D. pulex* and *D. rosea*. Additionally, one very large copepod species, *D. shoshone*, was prominent in Oyster Lake. Other *Diaptomus* species often present include *D. coloradensis* and *D. arapahoensis*. The unique species assemblages confined to high elevation lakes in the Rockies elicit monitoring possibilities. Should the acid sensitivity of the assemblage and/or each component be determined (for example, toxicity testing either in situ or in a laboratory) acidification responses could be predicted. Although few data are currently available, future use of the unique zooplankton communities of the study lakes could provide invaluable monitoring tools.

Acute and chronic acidification effects upon macroinvertebrate population structure would be evident for longer periods than effects on plankton. This would occur because succession (resulting from emergence [loss] and reproduction [gain]) is generally much slower in macroinvertebrates than the plankton. Additionally, a few genera of macroinvertebrates that occur in the study lakes have been shown to be either pH sensitive or tolerent at values of 6.5 and lower. Although responses of these genera (for example, *N. obscura* and *G. lacustris*) may be quite different in these particular systems, changes would be suggestive. Finally, because benthic macroinvertebrates and their terrestrial adults constitute a major food source for game fish (trout) of the lakes, population changes could prove disasterous for fish stocks. For these reasons, the macroinvertebrates should be included in monitoring plans.

No data were gathered concerning salamander populations in the one study lake (Oyster) that contained a dense population. This species may serve as an indicator of acidifying conditions because it breeds in ponds subject to concentrations of snowmelt pollutants. Once pH sensitivity limits are determined, *Ambystoma tirgrinum* could prove to be a useful monitoring tool. However, at present, we can only suggest recording salamander observations. Intense population studies might be useful should perturbations occur, but such surveys are time and cost intensive.

Fish tissue and sediment metal concentrations are highly variable, reducing their value for routine monitoring. However, baseline data should be determined for non-stressed fish tissue and sediments metal concentration in others to document effects of large scale perturbations if they should occur.

Fish population protection is probably of utmost importance. We have access to no current data, but some may be available from State agencies. Population surveys, although time intensive, are often necessary to quantify population changes. Alternative data sources for trout from the study lakes and similar lakes in the wilderness areas of Colorado may be utilized. Creel surveys and license questionaires could be used to assess fish population status from any region of interest.

Chemical Monitoring

Exclusive use of water chemistry monitoring as a tool to detect early signs of lake acidification should be avoided. Although pH and alkalinity, sulfate, and nitrate may be the most responsive parameters, instantaneous measurements may not record pulse events of short duration. This drawback can be overcome, however, by more frequent sampling at selected times of the year. Annual data collection during spring snowmelt would likely determine significant deposition and water quality trends in acidity. In such remote areas, the strategy not only would be difficult, it could be dangerous. Consequently, the practice is seldom carried out. Key water quality parameters to be included in monitoring program include various nitrogen species (for example, NO_2, NO_3 and NH_3), sulfates, pH, conductivity and alkalinity. These parameters are all directly influenced by acid inputs. Total phosphorus is a highly desirable parameter because of its importance to phytoplankton and periphyton crops. Similarly, dissolved oxygen and temperature profiles should be recorded at deep sites to assist in the interpretation of biological data. Organic carbon, both total and dissolved, should be monitored because of its potential for interacting with metals in the water column. Dissolved inorganic carbon measurements should also be included, if possible, because of the important relationship between carbon dioxide, pH and biological activity. Because several potentially toxic metals are associated with native bedrock and soils within these watersheds, it is suggested that annual scans be conducted for total and dissolved aluminum, copper, lead, nickel, silver and iron. Calcium and magnesium should also be monitored yearly because of their mitigating effects on the toxicity of other metals.

Lake Sensitivity

The three Flat Tops lakes, from which data are summarized in this report, are biologically and chemically similar. Minor differences occur that affect each lake's sensitivity to acid deposition. Ned Wilson, possessing an alkalinity of less than 80 µeq/l, obviously is the most sensitive chemically, whereas Oyster Lake is least sensitive. Available literature suggests the biological communities of the study lakes are sensitive to acidification, with major impacts expected as water pH drops below 5.5. Toxicity testing of unique high mountain species or assemblages and intensive lake surveys could provide sensitivity and distribution data lacking at present. When more data are available, precise lake biological sensitivity can be better determined.

Although more specific information would be required to assess the actual order of lake biological sensitivity, certain points can be presented. Salmonid populations of Ned Wilson Lake and Upper Island Lake probably will not be affected by acidification unless natural reproduction is occuring and lake pH drops to 5.5 or less. Other biota likely will be affected prior to trout population depletion. The order of biological community components (species) lost and pH levels at which they are lost can not be accurately predicted at present. Community structural changes, however, have been documented around the country and in Europe which suggest group trends within each community during acidification. Monitoring for these community perturbations and corresponding basic chemical and physical parameters should detect early signs of ecosystem disruption. This report provides a baseline data set and standard sampling methodologies which will hopefully assist management decisions and proper protection of the unique lakes of the Flat Tops Wilderness Area and other areas of the Rocky Mountains.

CONCLUSIONS

Components of the Flat Tops lakes zooplankton, phytoplankton and fish communities are subject to alterations as the pH of water approaches 5.5, and certain macroinvertebrate species are known to be sensitive to waters with pH values of 6.0 to 6.5. Once these levels are reached, disruptions will be expected in the biotic communities of the study lakes. Currently, summer daytime pH levels in all three study lakes are typically above 6.0.

Within-lake differences in phytoplankton assemblages were apparent in all lakes. However, between-station and depth related variability were largely attributable to rare species with dominant and co-dominant species relatively uniformly distributed throughout each lake. Discrete samples taken at 1, 5 and 10 m from the deep site on Upper Island Lake yielded slightly more diverse assemblages at 1 m than at 5 and 10 m. The majority of taxa collected at the various strata were present in the 1 m sample, suggesting that a near surface sample taken from a stratified lake will collect most of the more common phytoplankton species.

Annual and seasonal variability of the phytoplankton community were high in all lakes. Also, between-lake differences in the composition and abundance of phytoplankton communities were apparent in samples collected on approximately the same dates. Because of differences in the succession patterns of the phytoplankton assemblages in the various lakes, and because different assemblages were noted in individual lakes during mid August of two successive years, it seems unlikely that once-a-year sampling will provide adequate data to depict long term changes in phytoplankton assemblages in the various lakes. Differences in succession patterns need to be further investigated during the open water period. It is recommended that near-surface (1-1.5 m), quantitative samples be collected and composited from 3 to 4 sites per lake at two week intervals in order to examine succession patterns. In addition, replicate, discrete, quantitative samples should be taken at three depths (such as 1.5, 5 and 10 m) during a period of strong stratification and again, during isothermal conditions, to examine distribution throughout the water column.

Zooplankton species richness in the three Flat Tops study lakes is low and changes in diversity will probably not be useful in future monitoring. However, permanent changes in community composition (acid sensitive and acid tolerant species) can be indicative of acidification. Sensitivity to acidification of the copepod species (Diaptomus spp.), having distributions restricted to high altitude lakes, are not known and their sensitivity should be determined for possible use in future monitoring.

Annual zooplankton differences within individual lakes, based upon August sampling during successive years, were minor. Differences that were noted were attributable principally to occurrences of rare species. Because within-lake variability between sites was also low, it appears that replicate, depth-integrated samples collected at a single deep site during the period of strong stratification would be adequate to characterize the zooplankton communities of the study lakes for purposes of showing differences between lakes and changes occurring over time.

Seasonal variability and succession patterns of zooplankton communities were not addressed in this study, consequently no conclusions or recommendations can be made regarding optimal sampling frequencies or seasons. Sampling at a single deep site at two-week intervals during the open water period would provide considerable information on succession patterns of zooplankton assemblages. Knowledge of these patterns would aid in the design of long-term monitoring programs with respect to required sampling frequencies and optimal sampling periods (for example, stratified vs. non-stratified lake conditions).

Different macroinvertebrate communities occupied the littoral (shoreline) and profundal (deep) zones of the three Flat Tops lakes. Qualitative sampling in the littoral zone yielded more diverse assemblages than were found in quantitative grab samples from the profundal zone. To adequately characterize macroinvertebrate communities of individual lakes it is essential that both zones be sampled. Because the acidification sensitivity of individual taxa is not well known, it is important to examine entire assemblages occupying various habitats using changes in indices of community structure, (such as diversity, richness and density) when possible.

Annual differences in various study lake's macroinvertebrate communities indices were significant, hence, frequent (yearly) sampling may be necessary to access annual variability. Because recruitment and emergence affect "seasonal" species population size, temporal variation during ice free periods should be determined at least once. Except for one shallow Ned Wilson Lake site, between-site macroinvertebrate community indices were not significantly different in any lake during either year, hence, replicate samples from one deep site should adequately assess the status of profundal invertebrate assemblages in these index lakes during future monitoring.

Salamanders in Oyster Lake may serve as useful monitors because they breed in pools subject to influx of snowmelt pollutants. Increased acidification of Oyster Lake could result in decreased population or loss of salamanders.

Limited sampling and visual observations revealed the presence of salmonids in two of the three study lakes. It is not known whether trout in these lakes are reproducing naturally or whether they are the result of repeated stocking. Because early life stages are more sensitive to acidification and associated effects (such as metal releases) than are adults, artificially maintained populations would not be good monitors of acidification induced changes. On the other hand, naturally reproducing populations would likely be affected by any reduction in ambient pH levels, or by additional releases or mobilization of metals because of the high vulnerability of egg and larvae stages. Determination of fish population structure and maintenance mechanisms is an initial essential step toward incorporation of fish surveys into a monitoring program.

Metal concentrations in whole homogenized brook trout were low in Ned Wilson Lake during both 1982 and 1983. Two specimens of cutthroat trout collected from Upper Island Lake during 1983 yielded levels of copper, nickel and zinc on order of magnitude higher than were found in Ned Wilson Lake brook trout. Concentrations in gills of fish from both lakes were much lower than in whole fish. Because these metals are biocumulative, it is recommended that analyses of whole fish (such as three specimens per lake) be conducted, once annually, to monitor tissue residue levels.

Concentrations of metals within sediments of the study lakes are within expected ranges for unimpacted Western U.S. water bodies. Because changes in sediment metal chemistry may occur as a result of increased metal inputs or changes in water chemistry, annual collection and analysis of sediment samples for metal content should be an integral component of a long-term monitoring program.

Physical and chemical water quality data for the study lakes were similar to those reported for other lakes in this region of Colorado. Mean alkalinity values were less than 100 µeq/l in two of the lakes, but exceeded 200 µeq/l in one lake. The pH levels in the low alkalinity lakes were 6.3 to 6.8, whereas pH in the third lake exceeded 8.0. Conductivity levels were typically low (64-112 µmhos/cm), reflecting the low concentration of dissolved substances in the water. Concentrations of total metals were also low, with aluminum, iron, calcium and magnesium being the most abundant metals. Toxic metals were not measured in concentrations that pose any hazard to aquatic life.

Key water quality parameters recommended for monitoring include the nitrogen species (NO_2, NO_3, and NH_3), sulfates, pH, alkalinity, conductivity, total phosphorus, temperature, dissolved oxygen, total and dissolved organic carbon and dissolved inorganic carbon. Annual scans of total recoverable and dissolved aluminum, copper, lead, nickel, iron, silver, calcium and magnesium should also be included.

Lack of acid sensitivity data for most species of organisms inhabiting the study lakes preclude concise predictions of biological response to acidification. Testing for acid sensitivity of certain potentially indicator species assemblages and whole lake ecosystems may help formulate accurate predictions of acid deposition effects on biota of high altitude lakes.

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APPENDIX A. PHYTOPLANKTON CELL ABUNDANCE DATA FROM FLAT TOPS LAKES SURVEYED DURING 1982.

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PROJECT:  ACID RAIN PROJECT (AR)                AREA:  NED WILSON LAKE (33)                     DATE:  JULY 21, 1982
STATION:  CENTER OF MOUTH OF NORTH COVE (231)                                                    SUBSTATION:    5
SAMPLER TYPE:  NON APPLICABLE (0)
NUMBER OF REPLICATES:   1     FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                               RAW DATA TABLES

   1ST LEVEL REFERENCE
        2ND LEVEL REFERENCE                              REPLICATES          COUNTS                  TOTAL FOR SP.
             GENUS/SPECIES

   CHLOROPHYTA
        CHLOROCOCCALES
             MONORAPHIDIUM SETIFORME (14010)               1 - 1      10.                                 10.
   BACILLARIOPHYCEAE
        FRAGILARIACEAE
             TABELLARIA FLOCCULOSA (72570)                 1 - 1       0.                                  0.
        NAVICULACEAE
             NAVICULA NOTHA (77930)                        1 - 1       0.                                  0.
   CYANOPHYTA
        CHROOCOCCALES
             DACTYLOCOCCOPSIS IRREGULARIS (88530)          1 - 1      10.                                 10.


                  TOTAL FOR   4 SPECIES BY REPLICATE:      1 - 1      20.

                  TOTAL FOR   1 REPLICATES,   4 SPECIES:              20.
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                                                                                                          PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                          AREA:  NED WILSON LAKE (23)
STATION:  CENTER OF MOUTH OF NORTH COVE (231)                                                  DATE:  AUGUST  4, 1982
SAMPLER TYPE:  NON APPLICABLE (0)                                                               SUBSTATION:   10
NUMBER OF REPLICATES:   1     FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                       RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                  REPLICATES           COUNTS                       TOTAL FOR SP.
           GENUS/SPECIES

  CHLOROPHYTA
      CHLOROCOCCALES
           SPHAEROCYSTIS SCHROETERI (13170)                  1 - 1     144.                                       144.
           ANKISTRODESMUS NANNOSELENE (13600)                1 - 1      12.                                        12.
           MONORAPHIDIUM SETIFORME (14010)                   1 - 1       2.                                         2.
            KIRCHNERIELLA CONTOTRRIA (14870)               1 - 1      32.                                     32.
           SELENASTRUM MINUTUM (16020)                       1 - 1       6.                                         6.
           DICTYOSPHAERIUM EHRENBERGIANUM (17260)            1 - 1     102.                                       102.
           CRUCIGENIA RECTANGULARIS (18430)                  1 - 1      24.                                        24.
           SCENEDESMUS BIJUGA (18870)                        1 - 1      12.                                        12.
           ELAKATOTHRIX GELATINOSA (21470)                   1 - 1       4.                                         4.
  CHRYSOPHYTA
      PRYMNESIALES
           CHRYSOCHROMULINA PARVA (63130)                    1 - 1       2.                                         2.
  BACILLARIOPHYCEAE
      CENTRALES
           CYCLOTELLA PSEUDOSTELLIGERA (64150)               1 - 1      10.                                        10.
      FRAGILARIACEAE
           FRAGILARIA CROTONENSIS (70850)                    1 - 1       0.                                         0.
           SYNEDRA SPP. (72110)                              1 - 1       0.                                         0.
           TABELLARIA FLOCCULOSA (72570)                     1 - 1       0.                                         0.
      NAVICULACEAE
           NAVICULA MINIMA (77690)                           1 - 1       0.                                         0.
           NAVICULA NOTHA (77930)                            1 - 1       6.                                         6.
           PINNULARIA BOREALIS (78830)                       1 - 1       0.                                         0.


                TOTAL FOR  17 SPECIES BY REPLICATE:          1 - 1     357.

                TOTAL FOR   1 REPLICATES,  17 SPECIES:                 357.
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PROJECT:  ACID RAIN PROJECT (AR)                 AREA:  NED WILSON LAKE (23)                      DATE:  AUGUST 17, 1982
STATION:  CENTER OF MOUTH OF NORTH COVE (231)                                                      SUBSTATION:    1
SAMPLER TYPE:  NON APPLICABLE (0)
NUMBER OF REPLICATES:   1     FIELD BIOLOGIST:  WES KINNEY (9)
NOTE:  NOT APPLICABLE (0)

                                                 RAW DATA TABLES

    1ST LEVEL REFERENCE
         2ND LEVEL REFERENCE                               REPLICATES            COUNTS                   TOTAL FOR SP.
              GENUS/SPECIES

    CHLOROPHYTA
         CHLOROCOCCALES
              SPHAEROCYSTIS SCHROETERI (13170)              1 - 1     142.                                    142.
               KIRCHNERIELLA CONTUTRPIA (14870)            1 - 1     32.                                     32.
              NEPHROCYTIUM AGARDHIANUM (15010)              1 - 1     344.                                    344.
              SELENASTRUM MINUTUM (16070)                   1 - 1      50.                                     50.
              DICTYOSPHAERIUM EHRENBERGIANUM (17260)        1 - 1     268.                                    268.
              CRUCIGENIA RECTANGULARIS (18430)              1 - 1      48.                                     48.
              ELAKATOTHRIX GELATINOSA (21470)               1 - 1     968.                                    968.
         ZYGNEMATALES
              COSMARIUNM SUCCISUM (29330)                  1 - 1       4.                                      4.
              EUASTRUM SPP. (30000)                         1 - 1       0.                                      0.
    CHRYSOPHYTA
         OCHROMONADALES
              DINOBRYON DIVERGENS (59020)                   1 - 1       4.                                      4.
         PRYMNESIALES
              CHRYSOCHROMULINA PARVA (63130)                1 - 1       4.                                      4.
    BACILLARIOPHYCEAE
         NAVICULACEAE
              NAVICULA RADIOSA VAR. PARVA (78090)           1 - 1       1.                                      1.


                   TOTAL FOR  12 SPECIES BY REPLICATE:      1 - 1    1868.

                   TOTAL FOR   1 REPLICATES,  12 SPECIES:            1868.
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                                                                                                  PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                          AREA:  NED WILSON LAKE (23)
STATION:  CENTER OF LAKE (232)                                                             DATE:  AUGUST 17, 1982
SAMPLER TYPE:  NON APPLICABLE (0)                                                           SUBSTATION:    2
NUMBER OF REPLICATES:    1      FIELD BIOLOGIST:  WES WINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                         RAW DATA TABLES

  1ST LEVEL REFERENCE
     2ND LEVEL REFERENCE
        GENUS/SPECIES                                          REPLICATES        COUNTS                  TOTAL FOR SP.

  CHLOROPHYTA
     CHLOROCCCCALES
        SPHAEROCYSTIS SCHROETERI (13170)                        1 - 1     498.                              498.
         KIRCHNERIELLA CONTOTRRIA (14870)                      1 - 1     32.                              32.
        KIRCHNERIELLA OBESA VAR. MAJOR (14990)                  1 - 1       8.                                8.
        NEPHROCYTIUM AGARDHIANUM (15010)                        1 - 1     244.                              244.
        SELENASTRUM MINUTUM (16020)                             1 - 1      52.                               52.
        DICTYOSPHAERIUM EHRENBERGIANUM (17260)                  1 - 1     272.                              272.
        CRUCIGENIA RECTANGULARIS (18430)                        1 - 1      20.                               20.
        ELAKATOTHRIX GELATINOSA (21470)                         1 - 1    1010.                             1010.
  CRYPTOPHYTA
     CRYPTOMONADACEAE
        RHODOMONAS MINUTA (48410)                               1 - 1       2.                                2.
  CHRYSOPHYTA
     OCHROMONADALES
        DINOBRYON DIVERGENS (59020)                             1 - 1       4.                                4.
  CYANOPHYTA
     CHROOCOCCALES
        MERISMOPEDIA TENUISSIMA (89010)                         1 - 1      24.                               24.


              TOTAL FOR  11 SPECIES BY REPLICATE:               1 - 1    2166.

              TOTAL FOR   1 REPLICATES,  11 SPECIES:                     2166.
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                                                                                                  PAGE  1

PROJECT:  ACID RAIN PROJECT (AR)                        AREA:  NED WILSON LAKE (23)                  DATE:  AUGUST 17, 1982
STATION:  CENTER OF MOUTH OF SOUTH COVE (233)                                                         SUBSTATION:    3
SAMPLER TYPE:  NON APPLICABLE (0.
NUMBER OF REPLICATES:   1      FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                  RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                  REPLICATES          COUNTS                     TOTAL FOR SP.
          GENUS/SPECIES

  CHLOROPHYTA
      CHLOROCOCCALES
          SPHAEROCYSTIS SCHROETERI (13170)                   1 - 1    856.                                        856.
           KIRCHNERIELLA CONTUTRRTA (14870)                1 - 1   144.                                        144.
          KIRCHNERIELLA OBESA VAR. MAJOR (14890)             1 - 1     96.                                          96.
          NEPHROCYTIUM AGARDHIANUM (15010)                   1 - 1    696.                                         096.
          SELENASTRUM MINUTUM (16020)                        1 - 1     26.                                          26.
          DICTYOSPHAERIUM EHRENBERGIANUM (17260)             1 - 1    366.                                         366.
          CRUCIGENIA RECTANGULARIS (18430)                   1 - 1      8.                                           8.
          SCENEDESMUS QUADRICAUDA (18880)                    1 - 1      8.                                           8.
          ELAKATOTHRIX GELATINOSA (21470)                    1 - 1    344.                                         644.
      ZYGNEMATALES
          COSMARIUNM SUCCISUM (29330)                       1 - 1     10.                                         10.
          MICRASTERIAS SP. (31000)                           1 - 1      0.                                          0.
  BACILLARIOPHYCEAE
      CENTRALES
          CYCLOTELLA SPP. (64100)                            1 - 1      1.                                           1.
      FRAGILARIACEAE
          FRAGILARIA CONSTRUENS VAR. VENTER (70790)          1 - 1      0.                                           0.
      NAVICULACEAE
          NAVICULA NOTHA (77930)                             1 - 1      0.                                           0.
          NAVICULA RADIOSA VAR. PARVA (78090;                1 - 1      6.                                           6.
          PINNULARIA SPP. (78870)                            1 - 1      0.                                           0.
          STAURONEIS ANCEPTS VAR. GRACILIS (79550)           1 - 1      0.                                           0.
      CYMBELLACEAE
          CYMBELLA MINUTA (81510)                            1 - 1      0.                                           0.
      NITZSCHIACEAE
          NITZSCHIA KUTZINGIANA (84230)                      1 - 1      0.                                           0.
  CYANOPHYTA
      OSCILLATORIALES
          SPIRULINA SPP. (94000)                             1 - 1      2.                                           2.
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PROJECT:  ACID RAIN PROJECT (AR)              AREA:  NFD WILSON LAKE (23)                        DATE:  AUGUST 17, 1982
STATION:  CENTER OF MOUTH OF SOUTH COVE (233)                                                     SUBSTATION:    3
SAMPLER TYPE:  NON APPLICABLE (0)
NUMBER OF REPLICATES:   1     FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                        RAW DATA TABLES

   1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE                                REPLICATES         COUNTS                    TOTAL FOR SP.
           GENUS/SPECIES

                    TOTAL FOR  20 SPECIES BY REPLICATE:       1 - 1    2864.

                    TOTAL FOR   1 REPLICATES,  20 SPECIES:             2864.
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PROJECT:  ACID RAIN PROJECT (AR)                              AREA:  NED WILSON LAKE (23)                        DATE:  AUGUST 17, 1982
STATION:  100 METERS OUT FROM EAST END OF LAKE (234)                                                             SUBSTATION:    4
SAMPLER TYPE:  NON APPLICABLE (0)
NUMBER OF REPLICATES:   1      FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                    RAW DATA TABLES

   1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE                                        REPLICATES           COUNTS                        TOTAL FOR SP.
           GENUS/SPECIES

  CHLOROPHYTA
      VOLVOCALES
           CHLOROGONIUM SPP. (3010)                                1 - 1       2.                                             2.
      CHLOROCOCCALES
           SPHAEROCYSTIS SCHROETERI (13170)                        1 - 1     240.                                           240.
            KIRCHNERIELLA CONTORTA (14870)                       1 - 1     32.                                           32.
           KIRCHNERIELLA OBESA VAR. MAJOR (14890)                  1 - 1      40.                                            40.
           NEPHROCYTIUM AGARDHIANUM (15010)                        1 - 1     584.                                           584.
           SELENASTRUM MINUTUM (16020)                             1 - 1     106.                                           106.
           DICTYOSPHAERIUM EHRENBERGIANUM (17260)                  1 - 1     400.                                           400.
           CRUCIGENIA RECTANGULARIS (18430)                        1 - 1     112.                                           112.
           ELAKATOTHRIX GELATINOSA (21470)                         1 - 1    1050.                                          1050.
      ZYGNEMATALES
           COSMARIUMM SUCCISUM (29330)                            1 - 1      10.                                            10.
  PYRRHOPHYTA
      DINOKONTAE
           GYMNODINIUM SPP. (42220)                                1 - 1       2.                                             2.
  CHRYSOPHYTA
      OCHROMONADALES
           DINOBRYON DIVERGENS (59020)                             1 - 1      34.                                            34.
  BACILLARIOPHYCEAE
      CENTRALES
           CYCLOTELLA SPP. (64100)                                 1 - 1       2.                                             2.
      NAVICULACEAE
           NAVICULA RADIOSA VAR. PARVA (78090)                     1 - 1       2.                                             2.


                  TOTAL FOR  14 SPECIES BY REPLICATE:              1 - 1    2616.


                  TOTAL FOR   1 REPLICATES,  14 SPECIES:                    2616.
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                                                                                                        PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                          AREA:  NED WILSON LAKE (23)
STATION:  CENTER OF MOUTH OF NORTH COVE (231)                                                     DATE:  SEPTEMBER 10, 1982
SAMPLER TYPE:  NON APPLICABLE (0)                                                                  SUBSTATION:     1
NUMBER OF REPLICATES:   1      FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                 RAW DATA TABLES

 1ST LEVEL REFERENCE
     2ND LEVEL REFERENCE
          GENUS/SPECIES                                   REPLICATES             COUNTS                        TOTAL FOR SP.

CHLOROPHYTIA
     CHLOROCCCCALES
           KIRCHNERIELLA CONTOTRRTA (14870)             1 -  1      16.
          KIRCHNERIELLA OBESA VAR. MAJOR (14890)          1 -  1      28.                                        16.
          NEPHROCYTIUM AGARDHIANUM (15010)                1 -  1    2048.                                          28.
          SELENASTRUM MINUTUM (16020)                     1 -  1     574.                                        2048.
          DICTYOSPHAERIUM EHRENBERGIANUM (17260)          1 -  1     760.                                         574.
          CRUCIGENIA RECTANGULARIS (18430)                1 -  1      76.                                         760.
          ELAKATOTHRIX GELATINOSA (21470)                 1 -  1      22.                                          76.
BACILLARIOPHYCEAE                                                                                                  22.
     CENTRALES
          CYCLOTELLA SPP. (64100)                         1 -  1       6.
                                                                                                                    6.

               TOTAL FOR   8 SPECIES BY REPLICATE:        1 -  1    3530.

               TOTAL FOR   1 REPLICATES,   8 SPECIES:               3530.
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                                                                                                    PAGE  1

PROJECT:  ACID RAIN PROJECT (AR)                   AREA:  NED WILSON LAKE (23)                  DATE:  OCTOBER  3, 1982
STATION:  CENTER OF MOUTH OF NORTH COVE (231)                                                    SUBSTATION:    1
SAMPLER TYPE:  NON APPLICABLE (0)
NUMBER OF REPLICATES:   1      FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                       RAW DATA TABLES

  1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE                                        REPLICATES            COUNTS                    TOTAL FOR SP.
            GENUS/SPECIES

  CHLOROPHYTA
       VOLVOCALES
            PEDINOMONAS MINUTISSIMA (461)                          1 -  1       40.                                       40.
            CHLAMYDOMONAS SPP. (1070)                              1 -  1        4.                                        4.
            CHLAMYDOMONAS DINOBRYONI (1080)                       1 -  1       40.                                       40.
       CHLOROCOCCALES
            NEPHROCYTIUM AGARDHIANUM (15010)                       1 -  1       80.                                       80.
            SELENASTRUM MINUTUM (16020)                            1 -  1      188.                                      188.
            DICTYOSPHAERIUM EHRENBERGIANUM (17260)                 1 -  1     1456.                                     1456.
            ELAKATOTHRIX GELATINOSA (21470)                        1 -  1      276.                                      276.
  PYRRHOPHYTA
       DINOKONTAE
            GYMNODINIUM SPP. (42220)                               1 -  1        5.                                        5.
            GYMNODINIUM ORDINATUM/? (42230)                       1 -  1       60.                                       60.
            PERIDINIUM WILLEI (44510)                              1 -  1        0.                                        0.
  CRYPTOPHYTA
       CRYPTOMONADACEAE
            CRYPTOMONAS EROSA (47910)                              1 -  1        2.                                        2.
       KATABLEPHARIDACEAE
            KATABLEPHARIS OVALIS (48700)                           1 -  1       32.                                       32.
  CHRYSOPHYTA
       CHROMULINALES
            KEPHYRION SP.P. (55680)                               1 -  1       20.                                       20.
            PSEUDOPEDINELLA ERKENSIS? (55710)                      1 -  1      120.                                      120.
       OCHROMONADALES
            OCHROMONAS SPP. (58120)                                1 -  1      180.                                      180.
            DINOBRYON DIVERGENS (59020)                            1 -  1        7.                                        7.
            PSEUDOKEPHYRION SPP. (59100)                          1 -  1       20.                                       20.
       PRYMNESIALES
            CHRYSOCHROMULINA PARVA (63130)                         1 -  1       36.                                       36.
  BACILLARIOPHYCEAE
       CENTRALES
            CYCLOTELLA SPP. (64100)                                1 -  1        4.                                        4.
  MISC

            MONADS (5-10 UM) (99900)                               1 -  1        8.                                        8.
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                                                                                                        PAGE  2
PROJECT:  ACID RAIN PROJECT (AR)                    AREA:  NED WILSON LAKE (23)                   DATE:  OCTOBER  3, 1982
STATION:  CENTER OF MOUTH OF NORTH COVE (231)                                                      SUBSTATION:    1
SAMPLER TYPE:  NON APPLICABLE (0)
NUMBER OF REPLICATES:    1      FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                    RAW DATA TABLES

  1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE                                         REPLICATES          COUNTS                  TOTAL FOR SP.
            GENUS/SPECIES

  MISC
            MONADS (<5 UM) (99991)                                   1 - 1     292.                                     292.


                    TOTAL FOR  21 SPECIES BY REPLICATE:              1 - 1    2869.

                    TOTAL FOR   1 REPLICATES,  21 SPECIES:                    2869.
```

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                                                                                                                    PAGE  1

PROJECT:  ACID RAIN PROJECT (AR)                         AREA:  OYSTER LAKE (74)                          DATE:  AUGUST 18, 1982
STATION:  ONE THIRD DISTANCE FROM EAST END (242)                                                          SUBSTATION:    3
SAMPLER TYPE:  NON APPLICABLE (0)
NUMBER OF REPLICATES:   1      FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                          RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                          REPLICATES              COUNTS                     TOTAL FOR SP.
          GENUS/SPECIES

  CHLOROPHYTA
      TETRASPORALES
          TETRASPORA LACUSTRIS (8880)                                1 - 1     500.                                         500.
      CHLOROCOCCALES
          OOCYSTIS SPP. (15210)                                      1 - 1      40.                                          40.
          CRUCIGENIA RECTANGULARIS (18430)                           1 - 1     100.                                         100.
  BACILLARIOPHYCEAE
      NAVICULACEAE
          NAVICULA RADIOSA (77660)                                   1 - 1      10.                                          10.
          PINNULARIA SPP. (78870)                                    1 - 1      10.                                          10.
      GOMPHONEMACEAE
          GOMPHONEMA SPP. (80300)                                    1 - 1      10.                                          10.


                 TOTAL FOR   6 SPECIES BY REPLICATE:                 1 - 1 .   670.


                 TOTAL FOR   1 REPLICATES,   6 SPECIES:                        670.
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                                                                                                   PAGE  1
PROJECT: ACID RAIN PROJECT (AR)                        AREA: OYSTER LAKE (34)
STATION: ONE THIRD DISTANCE FROM WEST END (341)                                           DATE: AUGUST 18, 1982
SAMPLER TYPE: NON APPLICABLE (0)                                                           SUBSTATION:    1
NUMBER OF REPLICATES:   1     FIELD BIOLOGIST: WES KINNEY (9)
NOTE: NOT APPLICABLE (0)

                                              RAW DATA TABLES

  1ST LEVEL REFERENCE
     2ND LEVEL REFERENCE                                    REPLICATES          COUNTS                      TOTAL FOR SP.
        GENUS/SPECIES
 CHLOROPHYTA
     VOLVOCALES
        CHLAMYDOMONAS SPP. (1870)                            1 - 1     255.                                     255.
     TETRASPORALES
        TETRASPORA LACUSTRIS (8590)                          1 - 1     160.                                     160.
 CRYPTOPHYTA
     CRYPTOMONADACEAE
        CRYPTOMONAS REFLEXA (47940)                          1 - 1      10.                                      10.
        RHODOMONAS MINUTA (48410)                            1 - 1      60.                                      60.
     KATABLEPHARIDACEAE
        KATABLEPHARIS OVALIS (48780)                         1 - 1     100.                                     100.
 CHRYSOPHYTA
     PRYMNESIALES
        CHRYSOCHROMULINA PARVA (63130)                       1 - 1     357.                                     357.
 BACILLARIOPHYCEAE
     NAVICULACEAE
        NAVICULA RADIOSA (77660)                             1 - 1       1.                                       1.
     NITZSCHIACEAE
        NITZSCHIA SPP. (84000)                               1 - 1       2.                                       2.
        NITZSCHIA PALEA (84050)                              1 - 1       1.                                       1.
 CYANOPHYTA
     NOSTOCALES
        ANABAENA SP. (95020)                                 1 - 1       1.                                       1.

                TOTAL FOR  10 SPECIES BY REPLICATE:          1 - 1     947.

                TOTAL FOR   1 REPLICATES,  10 SPECIES:                 947.
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                                                                                                                    PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)
STATION:  COVE IN NORTHWEST END OF LAKE (251)        AREA:  UPPER ISLAND LAKE (25)                     DATE:  AUGUST 20, 1982
SAMPLER TYPE:  NON APPLICABLE (0)                                                                      SUBSTATION:      1
NUMBER OF REPLICATES:    1      FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                  RAW DATA TABLES

1ST LEVEL REFERENCE
     2ND LEVEL REFERENCE
          GENUS/SPECIES                                    REPLICATES             COUNTS                    TOTAL FOR SP.
CHLOROPHYTA
     TETRASPORALES
          TETRASPORA LACUSTRIS (8580)
     CHLOROCOCCALES                                         1 - 1      48.
          ANKISTRODESMUS NANNOSELENE (13600)                                                                        48.
          MONORAPHIDIUM PUSILLUM (14020)                    1 - 1     416.
          ELAKATOTHRIX GELATINOSA (21470)                   1 - 1       8.                                         416.
     ZYGNEMATALES                                           1 - 1      34.                                           8.
          STAURASTRUM SPP. (31320)                                                                                  34.
PYRRHOPHYTA                                                 1 - 1       0.
     DINOKONTAE                                                                                                      0.
          PERIDINIUM WILLEI (44510)
CRYPTOPHYTA                                                 1 - 1       0.
     CRYPTOMONADACEAE                                                                                                0.
          CRYPTOMONAS SPP. (47900)
          CRYPTOMONAS REFLEXA (47940)                       1 - 1       4.
          RHODOMONAS MINUTA (48410)                         1 - 1      12.                                           4.
CHRYSOPHYTA                                                 1 - 1     142.                                          12.
     PRYMNESIALES                                                                                                  142.
          CHRYSOCHROMULINA PARVA (63130)
BACILLARIOPHYCEAE                                           1 - 1      62.
     NAVICULACEAE                                                                                                   62.
          NAVICULA NOTHA (77930)
     NITZSCHIACEAE                                          1 - 1       2.
          NITZSCHIA KUTZINGIANA (84230)                                                                              2.
CYANOPHYTA                                                  1 - 1       4.
     OSCILLATORIALES                                                                                                 4.
          OSCILLATORIA SPP. (92000)
                                                            1 - 1       0.
                                                                                                                     0.


               TOTAL FOR  13 SPECIES BY REPLICATE:         1 - 1     732.

               TOTAL FOR   1 REPLICATES,  13 SPECIES:                732.
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PROJECT:  ACID RAIN PROJECT (AR)                       AREA:  UPPER ISLAND LAKE (25)                      DATE:  AUGUST 20, 1982
STATION:  NORTHEAST END OF LAKE (252)                                                                     SUBSTATION:    2
SAMPLER TYPE:  NON APPLICABLE (0)
NUMBER OF REPLICATES:   1     FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                          RAW DATA TABLES

   1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
         GENUS/SPECIES                                       REPLICATES          COUNTS                         TOTAL FOR SP.

   BACILLARIOPHYCEAE
      NAVICULACEAE
         PINNULARIA SPP. (78020)                              1 - 1      12.
      NITZSCHIACEAE                                                                                             12.
         NITZSCHIA SPP. (84000)                               1 - 1      20.
         NITZSCHIA ACICULARIS (84010)                         1 - 1       8.                                    20.
   CYANOPHYTA                                                                                                    8.
      OSCILLATORIALES
         OSCILLATORIA SPP. (92000)                            1 - 1       5.
   MISC                                                                                                          5.

         MONADS (<5 UM) (99991)                               1 - 1      10.
                                                                                                                10.

                   TOTAL FOR  24 SPECIES BY REPLICATE:        1 - 1    1049.

                   TOTAL FOR   1 REPLICATES,  24 SPECIES:              1049.
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                                                                                                        PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                          AREA:  UPPER ISLAND LAKE (25)                   DATE:  AUGUST 20, 1982
STATION:  NORTHEAST END OF LAKE (292)                                                                     SUBSTATION:    2
SAMPLER TYPE:  NON APPLICABLE (0)
NUMBER OF REPLICATES:   1     FIELD BIOLOGIST:  M&R KINNEY (9)
NOTE:  NOT APPLICABLE (0)

                                                         RAW DATA TABLES

   1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE                                   REPLICATES          COUNTS                         TOTAL FOR SP.
           GENUS/SPECIES

   CHLOROPHYTA
       VOLVOCALES
           CHLAMYDOMONAS SPP. (1870)                          1 -  1      52.                                        52.
       CHLOROCCCCALES
           ANKISTRODESMUS NANNOSELENE (13600)                 1 -  1     400.                                       400.
           MONORAPHIDIUM PUSILLUM (14020)                     1 -  1      13.                                        13.
           DICTYOSPHAERIUM EHRENBERGIANUM (17260)             1 -  1      92.                                        92.
           SCENEDESMUS SPP. (18960)                           1 -  1       8.                                         8.
           SCENEDESMUS BIJUGA (18870)                         1 -  1       4.                                         4.
           PEDIASTRUM BORYANUM VAR. (20730)                   1 -  1       8.                                         8.
           ELAKATOTHRIX GELATINOSA (21470)                    1 -  1      80.                                        80.
       ZYGNEMATALES
           SPIROGYRA SPP. (27320)                             1 -  1      42.                                        42.
           STAURASTRUM SPP. (31320)                           1 -  1       2.                                         2.
   PYRRHOPHYTA
       DINOKONTAE
           PERIDINIUM WILLEI (44810)                          1 -  1       0.                                         0.
   CRYPTOPHYTA
       CRYPTOMONADACEAE
           CRYPTOMONAS REFLEXA (47840)                        1 -  1      10.                                        10.
           RHODOMONAS MINUTA (48410)                          1 -  1     153.                                       153.
       KATABLEPHARIDACEAE
           KATABLEPHARIS OVALIS (48780)                       1 -  1       4.                                         4.
   CHRYSOPHYTA
       OCHROMONADALES
           OCHROMONAS SPP. (58120)                            1 -  1       2.                                         2.
       PRYMNESIALES
           CHRYSOCHROMULINA PARVA (63130)                     1 -  1     100.                                       100.
   BACILLARIOPHYCEAE
       CENTRALES
           CYCLOTELLA STELLIGERA (64130)                      1 -  1      11.                                        11.
       FRAGILARIACEAE
           SYNEDRA SPP. (72110)                               1 -  1       4.                                         4.
       NAVICULACEAE
           NAVICULA SPP. (77520)                              1 -  1       9.                                         9.
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PROJECT:  ACID RAIN PROJECT (AR)                         AREA:  UPPER ISLAND LAKE (25)
STATION:  BETWEEN SOUTH END OF ISLAND AND POINT ON NW SHORE (253)                              DATE:  AUGUST 20, 1982
SAMPLER TYPE:  NON APPLICABLE (0)                                                                SUBSTATION:    3
NUMBER OF REPLICATES:   1     FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                 RAW DATA TABLES

  1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE
            GENUS/SPECIES                                  REPLICATES        COUNTS                 TOTAL FOR SP.

 CHLOROPHYTA
      VOLVOCALES
            CHLAMYDOMONAS SPP. (1870)                      1 - 1     2.                                   2.
      CHLOROCOCCALES
            ANKYRA JUDAYI (10030)                          1 - 1     2.                                   2.
            ANKISTRODESMUS NANNOSELENE (13600)             1 - 1   218.                                 218.
            SCENEDESMUS BIJUGA (18870)                     1 - 1    16.                                  16.
            ELAKATOTHRIX GELATINOSA (21470)                1 - 1    36.                                  36.
      ZYGNEMATALES
            SPIROGYRA SPP. (27320)                         1 - 1     0.                                   0.
            STAURASTRUM SPP. (31320)                       1 - 1     0.                                   0.
 PYRRHOPHYTA
      DINOKONTAE
            GYMNODINIUM SPP. (42220)                       1 - 1     0.                                   0.
            PERIDINIUM WILLEI (44510)                      1 - 1     0.                                   0.
 CRYPTOPHYTA
      CRYPTOMONADACEAE
            CRYPTOMONAS REFLEXA (47940)                    1 - 1    21.                                  21.
            CRYPTOMONAS PYRENOIDIFERA (47950)              1 - 1     3.                                   3.
            RHODOMONAS MINUTA (48410)                      1 - 1   144.                                 144.
 CHRYSOPHYTA
      PRYMNESIALES
            CHRYSOCHROMULINA PARVA (63130)                 1 - 1    52.                                  52.
 BACILLARIOPHYCEAE
      CENTRALES
            CYCLOTELLA STELLIGERA (64130)                  1 - 1    30.                                  30.
      FRAGILARIACEAE
            SYNEDRA SPP. (73110)                           1 - 1     6.                                   6.
      NAVICULACEAE
            NAVICULA SPP. (77520)                          1 - 1     4.                                   4.
            PINNULARIA SPP. (78820)                        1 - 1    10.                                  10.
      NITZSCHIACEAE
            NITZSCHIA SPP. (84000)                         1 - 1     2.                                   2.
 CYANOPHYTA
      OSCILLATORIALES
            OSCILLATORIA LIMNETICA (92030)                 1 - 1     0.                                   0.
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PROJECT:  ACID RAIN PROJECT (AR)                            AREA:  UPPER ISLAND LAKE (35)
STATION:  BETWEEN SOUTH END OF ISLAND AND POINT ON NW SHORE (253)                          DATE:  AUGUST 20, 1982
SAMPLER TYPE:  NON APPLICABLE (0)                                                          SUBSTATION:    3
NUMBER OF REPLICATES:   1      FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                             RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
          GENUS/SPECIES                                  REPLICATES          COUNTS                    TOTAL FOR SP.

  CYANOPHYTA
      NOSTOCALES
          ANABAENA SP. (95020)
  MISC                                                     1 - 1       2.
                                                                                                          2.
          MONADS (5-10 UM) (99900)
          MONADS (<5 UM) (99991)                           1 - 1      14.
                                                           1 - 1      16.                                14.
                                                                                                         16.

                 TOTAL FOR  22 SPECIES BY REPLICATE:       1 - 1     579.

                 TOTAL FOR   1 REPLICATES,  22 SPECIES:              579.
```

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                                                                                                              PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                              AREA:  UPPER ISLAND LAKE (25)
STATION:  BETWEEN SOUTH END OF ISLAND AND SOUTH SHORE (254)                                           DATE:  AUGUST 20, 1982
SAMPLER TYPE:  NON APPLICABLE (0)                                                                     SUBSTATION:    4
NUMBER OF REPLICATES:   1      FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                        RAW DATA TABLES

    1ST LEVEL REFERENCE
        2ND LEVEL REFERENCE
            GENUS/SPECIES                                         REPLICATES          COUNTS                       TOTAL FOR SP.

    CHLOROPHYTA
        VOLVOCALES
            CHLAMYDOMONAS SPP. (1870)
        CHLOROCOCCALES                                           1 - 1      2.
            ANKISTRODESMUS NANNOSELENE (13600)                                                                          2.
            MONORAPHIDIUM PUSILLUM (14020)                       1 - 1    114.
            DICTYOSPHAERIUM EHRENBERGIANUM (17260)               1 - 1     98.                                        114.
            ELAKATOTHRIX GELATINOSA (21470)                      1 - 1     32.                                         98.
        ZYGNEMATALES                                             1 - 1     40.                                         32.
            SPIROGYRA SPP. (27320)                                                                                     40.
    PYRRHOPHYTA                                                  1 - 1      0.
        DINOKONTAE                                                                                                      0.
            GYMNODINIUM SPP. (42220)
            PERIDINIUM WILLEI (44510)                            1 - 1      1.
    CRYPTOPHYTA                                                  1 - 1      0.                                          1.
        CRYPTOMONADACEAE                                                                                                0.
            CRYPTOMONAS REFLEXA (47940)
            RHODOMONAS MINUTA (48410)                            1 - 1      6.
        KATABLEPHARIDACEAE                                       1 - 1    298.                                          6.
            KATABLEPHARIS OVALIS (48780)                                                                              298.
    CHRYSOPHYTA                                                  1 - 1      2.
        PRYMNESIALES                                                                                                    2.
            CHRYSOCHROMULINA PARVA (63130)
    BACILLARIOPHYCEAE                                            1 - 1     34.
        CENTRALES                                                                                                      34.
            CYCLOTELLA STELLIGERA (64130)
        NITZSCHIACEAE                                            1 - 1     24.
            NITZSCHIA SPP. (84000)                                                                                     24.
    MISC                                                         1 - 1      2.
                                                                                                                        2.
            MONADS (45 UM) (99991)
                                                                 1 - 1     24.                                         24.
```

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                                                                                                  PAGE  2

PROJECT:  ACID RAIN PROJECT (AR)                       AREA:  UPPER ISLAND LAKE (25)                       DATE:  AUGUST 30, 1982
STATION:  BETWEEN SOUTH END OF ISLAND AND SOUTH SHORE (254)                                                 SUBSTATION:    4
SAMPLER TYPE:  NON APPLICABLE (0)
NUMBER OF REPLICATES:   1      FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                       RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                      REPLICATES            COUNTS                          TOTAL FOR SP.
          GENUS/SPECIES

              TOTAL FOR  15 SPECIES BY REPLICATE:        1 - 1     677.

              TOTAL FOR   1 REPLICATES,  15 SPECIES:               677.
```

APPENDIX B. PHYTOPLANKTON CELL ABUNDANCE DATA FROM FLAT TOPS LAKES SURVEYED DURING 1983.

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                                                                                                    PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)
STATION:  NICLAKE, TURK'S HOUY; DEPTH  5.3M  (232)     AREA:  NED WILSON LAKE (23)             DATE:  APRIL 14, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                              SUBSTATION:    2
NUMBER OF REPLICATES:   1     FIELD BIOLOGIST:  FRANK MORRIS (65)
NOTE:  NOT APPLICABLE (0)


                                              RAW DATA TABLES

   1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
         GENUS/SPECIES                                     REPLICATES          COUNTS                   TOTAL FOR SP.

   CHLOROPHYTA
      VOLVOCALES
         CHLAMYDOMONAS SPP. (1070)
      CHLOROCOCCALES                                        1 - 1       20.00
         SPHAEROCYSTIS SCHROETERI (13170)                                                                 20.00
   PYRRHOPHYTA                                              1 - 1    37240.00
      DINOPHYTAE                                                                                       37240.00
         GYMNODINIUM SPP. (42220)
   CRYPTOPHYTA                                              1 - 1       20.00
      CRYPTOMONADACEAE                                                                                    20.00
         RHODOMONAS MINUTA (48410)
   BACILLARIOPHYCEAE                                        1 - 1       20.00
      CYMBELLACEAE                                                                                        20.00
         CYMBELLA MINUTA (81510)
   CYANOPHYTA                                               1 - 1       40.00
      CHROOCOCCALES                                                                                       40.00
         MERISMOPEDIA TENUISSIMA (89010)
                                                            1 - 1      160.00
                                                                                                         160.00


            TOTAL FOR   6 SPECIES BY REPLICATE:             1 - 1    37500.

            TOTAL FOR   1 REPLICATES,   6 SPECIES:                   37500.

            -
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PROJECT:  ACID RAIN PROJECT (AP)                        AREA:  NED WILSON LAKE (23)
STATION:  MIDLAKE, TURK'S BOUY; DEPTH  5.3M  (232)                                                  DATE:  JUNE 28, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                                  SUBSTATION:     6
NUMBER OF REPLICATES:   1      FIELD BIOLOGIST:  USGS SAMPLING CREW (UC)
NOTE:  NOT APPLICABLE (0)

                                                    RAW DATA TABLES

   1ST LEVEL REFERENCE
        2ND LEVEL REFERENCE                                         REPLICATES            COUNTS                      TOTAL FOR SP.
             GENUS/SPECIES

   CHLOROPHYTA
        VOLVOCALES
             CHLAMYDOMONAS SPP. (1870)                               1 -  1      80.00                                      80.00
        CHLOROCOCCALES
             SCHROEDERIA SETIGERA (10600)                            1 -  1      40.00                                      40.00
             DICTYOSPHAERIUM EHRENBERGIANUM (17260)                  1 -  1   10760.00                                   10760.00
   PYRRHOPHYTA
        DINOKONTAE
             GYMNODINIUM ORDINATUM (42230)                           1 -  1      60.00                                      60.00
   CHRYSOPHYTA
        PRYMNESIALES
             CHRYSOCHROMULINA SP. (63120)                            1 -  1     150.00                                     150.00
   CYANOPHYTA
        OSCILLATORIALES
             PHORMIDIUM MUCICOLA (93040)                             1 -  1     140.00                                     140.00


               TOTAL FOR   6 SPECIES BY REPLICATE:                   1 -  1   11230.

               TOTAL FOR   1 REPLICATES,    6 SPECIES:                        11230.
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```
PROJECT:  ACID RAIN PROJECT (AR)                      AREA:  NEP VITSCH LAKE (23)
STATION:  PICLAKE, TURK'S BOUY; DEPTH  5.3M  (232)                                          DATE:  JULY 20, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                           SUBSTATION:    2
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  URGA SAMPLING CREW (UC)
NOTE:  NOT APPLICABLE (0)

                                               RAW DATA TABLES

 1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
           GENUS/SPECIES                                    REPLICATES          COUNTS

                                                                                                              TOTAL FOR SP.
 CHLOROPHYTA
      VOLVOCALES
           CHLAMYDOMONAS SPP. (1870)                          1 - 2        0.00      110.00                        110.00
      CHLOROCOCCALES
           SCHROEDERIA SETIGERA (10600)                       1 - 2        0.10        0.00                          0.10
           NEPHROCYTIUM SP. (15000)                           1 - 2        0.00      120.00                        120.00
 PYRRHOPHYTA
      DINOKONTAE
           GYMNODINIUM ORDINATUM (42230)                      1 - 2        0.00      110.00                        110.00
           GLENODIUM OCULATUM (44010)                         1 - 2        2.80        0.00                          2.80
           GLENODINUM GYMNODINUM (44020)                      1 - 2        0.20        0.00                          0.20
           PERIDINIUM QUADRIDENS (44530)                      1 - 2        0.40        0.00                          0.40
 CRYPTOPHYTA
      CRYPTOMONADACEAE
           CRYPTOMONAS EROSA (47910)                          1 - 2        0.00       30.00                         30.00
 CHRYSOPHYTA
      PRYMNESIALES
           CHRYSOCHROMULINA PARVA (63130)                     1 - 2        0.00      770.00                        770.00
 BACILLARIOPHYCEAE
      CENTRALES
           CYCLOTELLA SPP. (64100)                            1 - 2        0.00     1340.00                       1340.00
 CYANOPHYTA
      OSCILLATORIALES
           PHORMIDIUM MUCICOLA (93040)                        1 - 2        0.00       10.00                         10.00

               TOTAL FOR  11 SPECIES BY REPLICATE:        1 - 2         4.    2490.

               TOTAL FOR   2 REPLICATES,  11 SPECIES:               2494.
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                                                                                                                  PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                        AREA:  NEW BITSON LAKE (23)
STATION:  MIDLAKE, TURK'S BOUT; DEPTH  5.3M  (232)                                                    DATE:  JULY 29, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                                     SUBSTATION:    2
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (BC)
NOTE:  NOT APPLICABLE (0)


                                                  RAW DATA TABLES

 1ST LEVEL REFERENCE
     2ND LEVEL REFERENCE
          GENUS/SPECIES                                   REPLICATES            COUNTS                          TOTAL PER SP.

 CHLOROPHYTA
     VOLVOCALES
          CHLAMYDOMONAS SPP. (1070)                         1 - 2       0.00     130.00
     CHLOROCOCCALES                                                                                                130.00
          GOLENKINIA SP. (10200)                            1 - 2       0.00      10.00
          NEPHROCYTIUM SP. (15000)                          1 - 2       0.80     160.00                             10.00
     ZYGNEMATALES                                                                                                  160.80
          COSMARIUM NANUM (29340)                           1 - 2       0.10       0.00
          XANTHIDIUM SMITHI (33000)                         1 - 2       0.00      10.00                              0.10
 PYRROPHYTA                                                                                                         10.00
     DINOPHYCEAE
          GYMNODINIUM ORDINATUM (42230)
          PERIDINIUM QUADRIDENS (44530)                     1 - 2       0.00      40.00
 CHRYSOPHYTA                                                1 - 2       0.10       0.00                             40.00
     CHROMULINALES                                                                                                   0.10
          DINOBRYON CYLINDRICUM (55030)
     PRYMNESIALES                                           1 - 2       0.10       0.00                              0.10
          CHRYSOCHROMULINA PARVA (63130)
 BACILLARIOPHYCEAE                                          1 - 2       0.00      60.00                             60.00
     NAVICULACEAE
          NAVICULA CRYPTOCEPHALA (77690)
     EPITHEMIACEAE                                          1 - 2       0.20       0.00                              0.20
          HANTZSCHIA VIRGATA VAR. CAPITELLATA (83450)       1 - 2       0.00      10.00                             10.00


               TOTAL FOR  11 SPECIES BY REPLICATE:          1 - 2       1.      420.

            -  TOTAL FOR   2 REPLICATES,  11 SPECIES:              421.
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                                                                                                   PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)
STATION:  MIDLAKE, TURK'S MOUTH; DEPTH  5.3M  (232)          AREA:  NED WILSON LAKE (23)
SAMPLER TYPE:  VAN DORN GRAB (33)                                                            DATE:  AUGUST 17, 1983
NUMBER OF REPLICATES:    2     FIELD BIOLOGIST:  USGS SAMPLING CREW (SC)                      SUBSTATION:    2
NOTE:  NOT APPLICABLE (0)

                                                 RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
          GENUS/SPECIES                                     REPLICATES          COUNTS                      TOTAL FOR SP.

  CHLOROPHYTA
      CHLOROCOCCALES
          NEPHROCYTIUM SP. (15000)
          DICTYOSPHAERIUM EHRENBERGIANUM (17260)            1 -  2      50.00       0.00
          CRUCIGENIA RECTANGULARIS (18430)                  1 -  2     270.00       0.00                           50.00
          ELAKATOTHRIX GELATINOSA (21470)                   1 -  2       0.00       2.40                          270.00
  EUGLENOPHYTA                                              1 -  2      60.00       0.00                            2.40
      EUGLENALES                                                                                                   60.00
          TRACHELOMONAS ROBUSTA (38010)
  PYRRHOPHYTA                                               1 -  2      10.00       0.00
      DINOPHYCEAE                                                                                                  10.00
          GYMNODINIUM ORDINATUM (42330)
  CHRYSOPHYTA                                               1 -  2      10.00       0.00
      OCHROMONADALES                                                                                               10.00
          OCHROMONAS SPP. (58120)
          DINOBRYON CYLINDRICUM (59030)                     1 -  2      80.00       0.00
  BACILLARIOPHYCEAE                                         1 -  2     350.00     122.00                           80.00
      NAVICULACEAE                                                                                                472.00
          NAVICULA CRYPTOPHALA VAR. INTERMEDIA (78110)      1 -  2      10.00       0.00
      GOMPHONEMACEAE                                                                                               10.00
          GOMPHONEMA ANGUSTATUM (80540)                     1 -  2      10.00       0.00
  CYANOPHYTA                                                                                                       10.00
      NOSTOCALES
          ANABAENA SP. (95020)
                                                            1 -  2       0.00       1.70                            1.70

              TOTAL FOR  11 SPECIES BY REPLICATE:           1 -  2     850.     126.

              TOTAL FOR  2 REPLICATES,  11 SPECIES:                    976.
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PROJECT:  ACID RAIN PROJECT (AR)                    AREA:  NEW WILSON LAKE (23)
STATION:  PICKARD, TURK'S BOUT; DEPTH  5.3M  (232)                                           DATE:  AUGUST 17, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                             SUBSTATION:    2
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (SC)
NOTE:  NOT APPLICABLE (0)

                                             RAW DATA TABLES

 1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
           GENUS/SPECIES                                      REPLICATES           COUNTS                                TOTAL FOR SP.

 CHLOROPHYTA
      CHLOROCOCCALES
           NEPHROCYTIUM SP. (19000)                           1 -  2        0.00      90.00                                     90.00
           DICTYOSPHAERIUM EHRENBERGIANUM (17260)             1 -  2        0.00     240.00                                    240.00
 CHRYSOPHYTA
      OCHROMONADALES
           DINOBRYON CYLINDRICUM (59030)                      1 -  2      207.00      70.00                                    277.00
      PRYMNESIALES
           CHRYSOCHROMULINA PARVA (63130)                     1 -  2        0.00      80.00                                     80.00
 BACILLARIOPHYCEAE
      FRAGILARIACEAE
           TABELLARIA FLOCCULOSA (72570)                      1 -  2        0.10       0.00                                      0.10
      NITZSCHIACEAE
           NITZSCHIA PALEA (84050)                            1 -  2        0.30       0.00                                      0.30
 CYANOPHYTA
      NOSTOCALES
           ANABAENA SP. (95020)                               1 -  2        2.20       0.00                                      2.20


                 TOTAL FOR   7 SPECIES BY REPLICATE:          1 -  2      210.      450.

                 TOTAL FOR   2 REPLICATES,    7 SPECIES:                  660.
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                                                                                                  PAGE  1

PROJECT:  ACID RAIN PROJECT (AR)                        AREA:  RED WITSCH LAKE (23)                DATE:  AUGUST 25, 1983
STATION:  EQUIDISTANT  3 SHORES-SE COVE; DEPTH 4.3M (231)                                          SUBSTATION:    1
SAMPLER TYPE:  VAN DORN GRAB (33)
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (SC)
NOTE:  4.0,2.5,0.5 M COMPOSITE DEPTH (9)

                                                    RAW DATA TABLES

   1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                       REPLICATES          COUNTS                        TOTAL FOR SP.
         GENUS/SPECIES

   CHLOROPHYTA
      CHLOROCOCCALES
         SCHROEDERIA SETIGERA (10600)                           1 - 2        0.00      20.00                         20.00
         NEPHROCYTIUM SP. (15000)                               1 - 2        0.00      30.00                         30.00
         DICTYOSPHAERIUM EHRENBERGIANUM (17280)                 1 - 2       99.60     510.00                        609.60
   CHRYSOPHYTA
      OCHROMONADALES
         DINOBRYON CYLINDRICUM (55030)                          1 - 2      159.40     630.00                        789.40
      PRYMNESIALES
         CHRYSOCHROMULINA PARVA (63130)                         1 - 2        0.00     910.00                        910.00
   BACILLARIOPHYCEAE
      FRAGILARIACEAE
         FRAGILARIA SPP. (70760)                                1 - 2        0.20       0.00                          0.20
         TABELLARIA FLOCCULOSA (72570)                          1 - 2        1.50       0.00                          1.50
      ACHNANTHACEAE
         COCCONEIS DIMINUTA (74080)                             1 - 2        0.00      10.00                         10.00
      NAVICULACEAE
         NAVICULA SPP. (77520)                                  1 - 2        0.30       0.00                          0.30
      NITZSCHIACEAE
         HANTZSCHIA SPP. (83420)                                1 - 2        0.10       0.00                          0.10
         NITZSCHIA PALEA (84050)                                1 - 2        0.00      10.00                         10.00
   CYANOPHYTA
      NOSTOCALES
         ANABAENA SP. (95030)                                   1 - 2       11.00       0.00                         11.00


                  TOTAL FOR  12 SPECIES BY REPLICATE:           1 - 2      272.     2120.

                  TOTAL FOR   2 REPLICATES,  12 SPECIES:                  2392.
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PROJECT:  ACID RAIN PROJECT (AR)                    AREA:  NED WILSON LAKE (23)                    DATE:  AUGUST 25, 1983
STATION:  MIDLAKE, TURK'S BOUT; DEPTH  5.3M  (232)                                                  SUBSTATION:    2
SAMPLER TYPE:  VAN DORN GRAB (33)
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (SC)
NOTE:  4.5,2.5,0.5 M COMPOSITE DEPTH (7)

                                                   RAW DATA TABLES

 1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                               REPLICATES           COUNTS                         TOTAL FOR SP.
           GENUS/SPECIES

 CHLOROPHYTA
      CHLOROCOCCALES
           DICTYOSPHAERIUM EHRENBERGIANUM (17260)        1 - 2      300.00     195.80                          495.80
           ELAKATOTHRIX GELATINOSA (21470)               1 - 2       20.00       2.10                           22.10
 CHRYSOPHYTA
      OCHROMONADALES
           DINOBRYON CYLINDRICUM (59030)                 1 - 2      700.00     237.10                          937.10
      PRYMNESIALES
           CHRYSOCHROMULINA PARVA (63130)                1 - 2      140.00       0.00                          140.00
 BACILLARIOPHYCEAE
      FRAGILARIACEAE
           TABELLARIA FLOCCULOSA (72570)                 1 - 2       20.00       0.30                           20.30
      NAVICULACEAE
           NAVICULA CRYPTOCEPHALA (77630)                1 - 2        0.00       1.00                            1.00
      CYMBELLACEAE
           CYMBELLA SPP. (81500)                         1 - 2        0.00       0.20                            0.20
 CYANOPHYTA
      NOSTOCALES
           ANABAENA SP. (95020)                          1 - 2        0.00       6.70                            6.70


                TOTAL FOR   8 SPECIES BY REPLICATE:      1 - 2     1180.      443.

                TOTAL FOR   2 REPLICATES,   8 SPECIES:            1623.
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                                                                                                          PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)
STATION:  EQUIDISTANT 3 SHORES-N COVE;  DEPTH 2.5M )(933)     AREA:  RED WITSCH LAKE (23)             DATE:  AUGUST 25, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                                      SUBSTATION:    3
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (UC)
NOTE:  3.0,1.5,0.5 M COMPOSITE DEPTH (8)

                                                RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
          GENUS/SPECIES                                      REPLICATES         COUNTS                          TOTAL FOR SP.

  CHLOROPHYTA
      CHLOROCOCCALES
          SCHROEDERIA SETIGERA (10600)
          DICTYOSPHAERIUM EHRENBERGIANUM (17260)             1 - 2       0.00     10.00
          PEDIASTRUM BORYANUM VAR. (20730)                   1 - 2     175.50    400.00                              10.00
          ELAKATOTHRIX GELATINOSA (21470)                    1 - 2       0.80      0.00                             575.50
  CHRYSOPHYTA                                                1 - 2       1.20      0.00                               0.80
      OCHROMONADALES                                                                                                  1.20
          DINOBRYON CYLINDRICUM (58030)
      PRYMNESIALES                                           1 - 2     170.60    320.00
          CHRYSOCHROMULINA SP. (63120)                                                                              490.60
  BACILLARIOPHYCEAE                                          1 - 2       0.00    470.00
      CENTRALES                                                                                                     470.00
          CYCLOTELLA SPP. (64100)
      FRAGILARIACEAE                                         1 - 2       0.40      0.00
          TABELLARIA FLOCCULOSA (72570)                                                                               0.40
      NAVICULACEAE                                           1 - 2       0.20      0.00
          NAVICULA CRYPTOCEPHALA (77630)                                                                              0.20
      NITZSCHIACEAE                                          1 - 2       0.50      0.00
          NITZSCHIA PALEA (84050)                                                                                     0.50
          NITZSCHIA KUTZINGIANA (84230)                      1 - 2       0.00     10.00
  CYANOPHYTA                                                 1 - 2       0.30      0.00                              10.00
      NOSTOCALES                                                                                                      0.30
          ANABAENA SP. (95020)
                                                             1 - 2       4.20      0.00
                                                                                                                      4.20

             TOTAL FOR  12 SPECIES BY REPLICATE:             1 - 2      354.     1210.

             TOTAL FOR   2 REPLICATES,  12 SPECIES:                 1564.
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                                                                                                   PAGE  1

PROJECT:  ACID RAIN PROJECT (AR)                    AREA:  NED WILSON LAKE (23)                    DATE:  AUGUST 25, 1983
STATION:  100M OFFSHORE-N SHALLOW COVE; DEPTH 5.0M (234)                                            SUBSTATION:    4
SAMPLER TYPE:  VAN DORN GRAB (33)
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (80)
NOTE:  NOT APPLICABLE (0)

                                              RAW DATA TABLES

   1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE                                      REPLICATES          COUNTS                     TOTAL FOR SP.
           GENUS/SPECIES

   CHLOROPHYTA
       CHLOROCOCCALES
           SCHROEDERIA SETIGERA (10600)                         1 -  2      20,00      0,00                       20,00
           NEPHROCYTIUM SP. (15000)                             1 -  2      10,00      0,00                       10,00
           DICTYOSPHAERIUM SP. (17250)                          1 -  2     890,00      0,00                      890,00
           DICTYOSPHAERIUM EHRENBERGIANUM (17260)               1 -  2       0,00     74,90                       74,90
           PEDIASTRUM SPP. (20710)                              1 -  2       0,00      0,40                        0,40
           ELAKATOTHRIX GELATINOSA (21470)                      1 -  2      50,00      1,40                       51,40
       OEDOGONIALES
           OEDOGONIUM (25300)                                   1 -  2       0,00      1,40                        1,40
       ZYGNEMATALES
           STAURASTRUM PROBOSCIDIUM (31350)                     1 -  2       0,00      0,10                        0,10
   PYRRHOPHYTA
       PERIDINIALES
           CERATIUM SP. (41120)                                 1 -  2       0,00     31,60                       31,60
   CHRYSOPHYTA
       OCHROMONADALES
           DINOBRYON CYLINDRICUM (99030)                        1 -  2     940,00    262,50                     1202,50
       PRYMNESIALES
           CHRYSOCHROMULINA SP. (63120)                         1 -  2     160,00      0,00                      160,00
   BACILLARIOPHYCEAE
       CENTRALES
           CYCLOTELLA SPP. (64100)                              1 -  2      10,00      0,00                       10,00
       NAVICULACEAE
           NAVICULA SPP. (77520)                                1 -  2       0,00      1,20                        1,20
       NITZSCHIACEAE
           NITZSCHIA SPP. (84000)                               1 -  2       0,00      1,60                        1,60
           NITZSCHIA PALEA (94050)                              1 -  2      10,00      0,00                       10,00
   CYANOPHYTA
       NOSTOCALES
           ANABAENA SP. (95020)                                 1 -  2     100,00     32,40                      132,40
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PROJECT:  ACID RAIN PROJECT (AR)                     AREA:  NED WILSON LAKE (23)
STATION:  1COP OFFSHORE-W SHALLOW COVE; DEPTH 5.0M (234)                                        DATE:  AUGUST 25, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                                SUBSTATION:    4
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (SC)
NOTE:  NOT APPLICABLE (0)


                                              RAW DATA TABLES

   1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE
           GENUS/SPECIES                                  REPLICATES          COUNTS                     TOTAL FOR SP.

                TOTAL FOR  16 SPECIES BY REPLICATE:       1 - 2    2190.    408.

                TOTAL FOR   2 REPLICATES,  16 SPECIES:             2598.
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                                                                                                              PAGE  1

PROJECT:  ACID RAIN PROJECT (AR)                    AREA:  NED WILSON LAKE (23)                    DATE:  AUGUST 30, 1983
STATION:  MIDLAKE, TURK'S BOUY; DEPTH  5.3M  (232)                                                   SUBSTATION:    2
SAMPLER TYPE:  VAN DORN GRAB (33)
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (80)
NOTE:  NOT APPLICABLE (0)

                                              RAW DATA TABLES

   1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE                                      REPLICATES         COUNTS                        TOTAL FOR SP.
           GENUS/SPECIES

   CHLOROPHYTA
       VOLVOCALES
           PEDINOMONAS SP. (460)                                 1 - 2      0.00    310.00                           310.00
       CHLOROCOCCALES
           SPHAEROCYSTIS SPP. (13160)                            1 - 2      0.00    170.00                           170.00
           OOCYSTIS SPP. (15310)                                 1 - 2      0.00     40.00                            40.00
           DICTYOSPHAERIUM EHRENBERGIANUM (17260)                1 - 2      0.00   1560.00                          1560.00
           ELAKATOTHRIX GELATINOSA (21470)                       1 - 2      0.00   1160.00                          1160.00
   PYRRHOPHYTA
       DINOKONTAE
           GYMNODINIUM ORDINATUM (42230)                         1 - 2      0.00     20.00                            20.00
   CRYPTOPHYTA
       CRYPTOMONADACEAE
           CRYPTOMONAS EROSA (47910)                             1 - 2      0.00     20.00                            20.00
   CHRYSOPHYTA
       OCHROMONADALES
           DINOBRYON SERTULARIA (59040)                          1 - 2     87.50      0.00                            87.50
       PRYMNESIALES
           CHRYSOCHROMULINA SP. (63120)                          1 - 2      0.00    350.00                           350.00
   BACILLARIOPHYCEAE
       FRAGILARIACEAE
           TABELLARIA FLOCCULOSA (73570)                         1 - 2      0.00     40.00                            40.00
   CYANOPHYTA
       OSCILLATORIALES
           PHORMIDIUM SPP. (93000)                               1 - 2      0.00    250.00                           250.00
       NOSTOCALES
           ANABAENA SP. (95030)                                  1 - 2     36.20      0.00                            36.20

          -
              TOTAL FOR  12 SPECIES BY REPLICATE:                1 - 2    124.     3920.

              TOTAL FOR   2 REPLICATES,  12 SPECIES:                     4044.
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PROJECT:  ACID RAIN PROJECT (AR)                    AREA:  RED BIRCH LAKE (23)                         DATE:  SEPTEMBER 10, 1983
STATION:  MIDLAKE, TURK'S BOUY; DEPTH  5.3M  (232)                                                      SUBSTATION:    2
SAMPLER TYPE:  VAN DORN GRAB (33)
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (SC)
NOTE:  NOT APPLICABLE (0)

                                                  RAW DATA TABLES

 1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                    REPLICATES           COUNTS                          TOTAL FOR SP.
           GENUS/SPECIES

CHLOROPHYTA
     CHLOROCOCCALES
          SCHROEDERIA SETIGERA (10600)                          1 - 2      0.00     170.00                              170.00
          SPHAEROCYSTIS SCHROETERI (13170)                      1 - 2      0.00      70.00                               70.00
          KIRCHNERIELLA SPP. (14060)                            1 - 2      0.00      40.00                               40.00
          OOCYSTIS BORGEI (15220)                               1 - 2      0.00     200.00                              200.00
          DICTYOSPHAERIUM EHRENBERGIANUM (17260)                1 - 2      0.00    1380.00                             1380.00
          ELAKATOTHRIX GELATINOSA (21470)                       1 - 2      0.00     320.00                              320.00
PYRRHOPHYTA
     DINOPHYCEAE
          GYMNODINIUM ORDINATUM (42230)                         1 - 2      0.00      10.00                               10.00
CHRYSOPHYTA
     OCHROMONADALES
          DINOBRYON CYLINDRICUM (55030)                         1 - 2     56.80       0.00                               56.80
     PRYMNESIALES
          CHRYSOCHROMULINA PARVA (63130)                        1 - 2      0.00     370.00                              370.00
BACILLARIOPHYCEAE
     FRAGILARIACEAE
          TABELLARIA SP. (72560)                                1 - 2      0.30       0.00                                0.30
     NAVICULACEAE
          NAVICULA SPP. (77520)                                 1 - 2      0.00      10.00                               10.00
     CYMBELLACEAE
          CYMBELLA SPP. (81500)                                 1 - 2      0.00      10.00                               10.00
CYANOPHYTA
     NOSTOCALES
          ANABAENA SP. (95020)                                  1 - 2      6.20       0.00                                6.20


                - TOTAL FOR  13 SPECIES BY REPLICATE:           1 - 2     63.    2580.

                  TOTAL FOR   2 REPLICATES,  13 SPECIES:                2643.
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                                                                                                   PAGE  1

PROJECT:  ACID RAIN PROJECT (AR)                AREA:  NEW WILSON LAKE (23)                  DATE:  SEPTEMBER 28, 1983
STATION:  MIDLAKE, TURK'S BOUY; DEPTH  5.3M  (212)                                            SUBSTATION:    2
SAMPLER TYPE:  VAN DORN GEAR (33)
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (8C)
NOTE:  NOT APPLICABLE (0)

                                              RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                        REPLICATES          COUNTS                    TOTAL FOR SP.
          GENUS/SPECIES

  CHLOROPHYTA
      CHLOROCOCCALES
          SCHROEDERIA SETIGERA (10600)                           1 -  2        0.00      30.00                        30.00
          NEPHROCYTIUM AGARDHIANUM (15010)                       1 -  2        0.00    4490.00                      4490.00
          DICTYOSPHAERIUM EHRENBERGIANUM (17260)                 1 -  2       17.90    1820.00                      1837.90
  PYRRHOPHYTA
      DINOKONTAE
          GYMNODINIUM SPP. (42220)                               1 -  2        0.00      10.00                        10.00
  CHRYSOPHYTA
      OCHROMONADALES
          DINOBRYON CYLINDRICUM (59030)                          1 -  2        0.10       0.00                         0.10
      PRYMNESIALES
          CHRYSOCHROMULINA PARVA (63130)                         1 -  2        0.00      70.00                        70.00
  BACILLARIOPHYCEAE
      FRAGILARIACEAE
          TABELLARIA FENESTRATA (72580)                          1 -  2        0.20       0.00                         0.20


                TOTAL FOR   7 SPECIES BY REPLICATE:              1 -  2         18.     6420.

                TOTAL FOR   2 REPLICATES,   7 SPECIES:                        6438.
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PROJECT:  ACID RAIN PROJECT (AR)                          AREA:  CRATER LAKE (24)
STATION:  EQUIDISTANT 3 SHORES,N END; DEPTH 3.0M (241)                                        DATE:  AUGUST 19, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                               SUBSTATION:    1
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (UC)
NOTE:  NOT APPLICABLE (0)

                                                  RAW DATA TABLES

  1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE
            GENUS/SPECIES                                   REPLICATES            COUNTS                        TOTAL FOR SP.

  CHLOROPHYTA
       VOLVOCALES
            PEDINOMONAS MINUTISSIMA (461)                     1 - 2       50.00        0.00                           50.00
       CHLOROCOCCALES
            SPHAEROCYSTIS SCHROETERI (13170)                  1 - 2      160.00        5.40                          165.40
            CRUCIGENIA RECTANGULARIS (18430)                  1 - 2      170.00       21.60                          191.60
       ZYGNEMATALES
            SPHAEROZOSMA VERTEBRATUM FORMA MINOR (27410)      1 - 2      670.00        0.00                          670.00
            COSMARIUM SPP. (29320)                            1 - 2        0.00        0.10                            0.10
            STAURASTRUM SPP. (31320)                          1 - 2       10.00        1.80                           11.80
  CRYPTOPHYTA
       CRYPTOMONADACEAE
            RHODOMONAS MINUTA (48410)                         1 - 2      230.00        0.00                          230.00
  CHRYSOPHYTA
       PRYMNESIALES
            CHRYSOCHROMULINA SP. (63120)                      1 - 2       80.00        0.00                           80.00
            CHRYSOCHROMULINA PARVA (63130)                    1 - 2       20.00        0.00                           20.00
  BACILLARIOPHYCEAE
       FRAGILARIACEAE
            FRAGILARIA SPP. (70760)                           1 - 2       10.00        0.00                           10.00
            FRAGILARIA CROTONENSIS (70850)                    1 - 2        0.00        0.60                            0.60
            TABELLARIA FLOCCULOSA (72570)                     1 - 2        0.00        1.00                            1.00
       NAVICULACEAE
            NAVICULA SPP. (77520)                             1 - 2        0.00        0.20                            0.20
       CYMBELLACEAE
            AMPHORA OVALIS (81040)                            1 - 2        0.00        0.10                            0.10
       NITZSCHIACEAE
            NITZSCHIA PALEA (84050)                           1 - 2       20.00        0.00                           20.00
  CYANOPHYTA
       NOSTOCALES
            ANABAENA SP. (95020)                              1 - 2        0.00       35.00                           35.00
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PROJECT:  ACID RAIN PROJECT (AR)                 AREA:  OYSTER LAKE (24)
STATION:  EQUIDISTANT 3 SHORESAN END; DEPTH 3.0M (241)                              DATE:  AUGUST 19, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                    SUBSTATION:     1
NUMBER OF REPLICATES:    2     FIELD BIOLOGIST:  USGS SAMPLING CREW (SC)
NOTE:  NOT APPLICABLE (0)

                                                RAW DATA TABLES

   1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
         GENUS/SPECIES                                  REPLICATES            COUNTS                        TOTAL FOR SP.

               TOTAL FOR  16 SPECIES BY REPLICATE:       1 - 2    1420.      66.

               TOTAL FOR   2 REPLICATES,  16 SPECIES:             1486.
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                                                                                                   PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                      AREA:  CRATER LAKE (24)
STATION:  EQUIDISTANT 3 SHORESAN END; DEPTH 3.0M (241)                                     DATE:  AUGUST 23, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                           SUBSTATION:    1
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (8C)
NOTE:  0.5,1.4,2.8 M COMPOSITE DEPTH (1C)

                                                     RAW DATA TABLES

  1ST LEVEL REFERENCE
     2ND LEVEL REFERENCE
        GENUS/SPECIES                                      REPLICATES          COUNTS                          TOTAL FOR SP.

  CHLOROPHYTA
     CHLOROCOCCALES
        SCHROEDERIA SETIGERA (10600)                        1 -  2        0.00      30.00                            30.00
        SPHAEROCYSTIS SCHROETERI (13170)                    1 -  2        0.00     320.00                           320.00
        QUADRIGULA SP. (20900)                              1 -  2        3.00      10.00                            13.00
     ZYGNEMATALES
        GONATOZYGON SP. (29200)                             1 -  2        0.10       0.00                             0.10
        STAURASTRUM SPP. (31320)                            1 -  2        0.00      10.00                            10.00
        STAURASTRUM GRACILE (31330)                         1 -  2        2.60       0.00                             2.60
  CRYPTOPHYTA
     CRYPTOMONADACEAE
        RHODOMONAS MINUTA (48410)                           1 -  2        0.00      50.00                            50.00
  BACILLARIOPHYCEAE
     CENTRALES
        CYCLOTELLA SPP. (64100)                             1 -  2        0.10       0.00                             0.10
     FRAGILARIACEAE
        SYNEDRA SPP. (72110)                                1 -  2        0.10       0.00                             0.10
     NAVICULACEAE
        NAVICULA BACILLUM (78100)                           1 -  2        0.00      10.00                            10.00
     CYMBELLACEAE
        CYMBELLA SPP. (81500)                               1 -  2        0.30       0.00                             0.30
        CYMBELLA MINUTA (81510)                             1 -  2        0.00      20.00                            20.00
     NITZSCHIACEAE
        NITZSCHIA PALEA (84050)                             1 -  2        0.00      30.00                            30.00
  CYANOPHYTA
     NOSTOCCALES
        ANABAENA SP. (95020)                                1 -  2        0.00     120.00                           120.00

              TOTAL FOR  14 SPECIES BY REPLICATE:           1 -  2          6.      600.

              TOTAL FOR   2 REPLICATES,  14 SPECIES:                      606.
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PROJECT:  ACID RAIN PROJECT (AR)                               AREA:  OYSTER LAKE (24)
STATION:  EQUIDISTANT 3 SHORES-ESE COVE; DEPTH 3.5M (242)                                          DATE:  AUGUST 23, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                                   SUBSTATION:    2
NUMBER OF REPLICATES:   2    FIELD BIOLOGIST:  USGS SAMPLING CREW (SC)
NOTE:  NOT APPLICABLE (0)

                                                      RAW DATA TABLES

  1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE
            GENUS/SPECIES                                 REPLICATES          COUNTS                        TOTAL FOR SP.

 CHLOROPHYTA
      CHLOROCOCCALES
            SPHAEROCYSTIS SCHROETERI (13170)               1 - 2      33.00     240.00                        273.00
            ANKISTRODESMUS SPIRALIS (13610)                1 - 2       0.00      60.00                         60.00
            CRUCIGENIA RECTANGULARIS (18430)               1 - 2      28.00     280.00                        308.00
            QUADRIGULA SP. (20900)                         1 - 2       1.60       0.00                          1.60
            ELAKATOTHRIX GELATINOSA (21470)                1 - 2       0.40       0.00                          0.40
      ZYGNEMATALES
            GONATOZYGON SP. (29200)                        1 - 2       0.20       0.00                          0.20
            STAURASTRUM SPP. (31320)                       1 - 2       2.70       0.00                          2.70
 CRYPTOPHYTA
      CRYPTOMONADACEAE
            RHODOMONAS MINUTA (48410)                      1 - 2       0.00     210.00                        210.00
 CHRYSOPHYTA
      PRYMNESIALES
            CHRYSOCHROMULINA PARVA (63130)                 1 - 2       0.00     530.00                        530.00
 BACILLARIOPHYCEAE
      FRAGILARIACEAE
            SYNEDRA SPP. (72110)                           1 - 2       0.80      10.00                         10.80
            TABELLARIA FLOCCULOSA (72570)                  1 - 2       0.20       0.00                          0.20
      NAVICULACEAE
            FRUSTULIA VULGARIS (76950)                     1 - 2       0.10       0.00                          0.10
            NAVICULA SPP. (77520)                          1 - 2       0.80       0.00                          0.80
            NAVICULA PUPULA (77590)                        1 - 2       0.00      10.00                         10.00
            NAVICULA RADIOSA (77660)                       1 - 2       0.10       0.00                          0.10
      CYMBELLACEAE
            CYMBELLA SPP. (81500)                          1 - 2       0.20       0.00                          0.20
 CYANOPHYTA
      OSCILLATORIALES
            PHORMIDIUM SPP. (93000)                        1 - 2       0.60       0.00                          0.60


                 TOTAL FOR  17 SPECIES BY REPLICATE:       1 - 2       65.     1340.

                 TOTAL FOR   2 REPLICATES, 17 SPECIES:              1405.
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PROJECT:  ACID RAIN PROJECT (AR)                  AREA:  CRATER LAKE (24)
STATION:  EQUIDISTANT 3 SHORES AND; DEPTH 3.0M (241)                                 DATE:  SEPTEMBER  1, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                     SUBSTATION:    1
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  FRANK MORRIS (69)
NOTE:  NOT APPLICABLE (0)

                                        RAW DATA TABLES

 1ST LEVEL REFERENCE
    2ND LEVEL REFERENCE
       GENUS/SPECIES                              REPLICATES        COUNTS                         TOTAL FOR SP.

CHLOROPHYTA
    TETRASPORALES
       TETRASPORA SP. (8570)                       1 - 2      20.00       0.00                         20.00
    CHLOROCOCCALES
       SCHROEDERIA SETIGERA (10600)                1 - 2      10.00       0.00                         10.00
       SPHAEROCYSTIS SCHROETERI (13170)            1 - 2    2010.00      44.40                       2054.40
       OOCYSTIS BORGEI (15220)                     1 - 2     100.00       0.00                        100.00
       CRUCIGENIA RECTANGULARIS (18430)            1 - 2       0.00      41.40                         41.40
    ZYGNEMATALES
       COSMARIUM SPP. (29320)                      1 - 2       0.00       0.10                          0.10
       STAURASTRUM SPP. (31320)                    1 - 2       0.00       3.20                          3.20
PYRRHOPHYTA
    DINOKONTAE
       GYMNODINIUM SPP. (42220)                    1 - 2      30.00       0.00                         30.00
       PERIDINIUM QUADRIDENS (44830)               1 - 2       0.00       0.10                          0.10
CRYPTOPHYTA
    CRYPTOMONADACEAE
       CRYPTOMONAS EROSA (47910)                   1 - 2      10.00       0.00                         10.00
       RHODOMONAS MINUTA (48410)                   1 - 2     240.00       0.00                        240.00
    KATABLEPHARIDACEAE
       KATABLEPHARIS OVALIS (48700)                1 - 2     170.00       0.00                        170.00
CHRYSOPHYTA
    PRYMNESIALES
       CHRYSOCHROMULINA PARVA (63130)              1 - 2      70.00       0.00                         70.00
BACILLARIOPHYCEAE
    FRAGILARIACEAE
       SYNEDRA DELICATISSIMA (72150)               1 - 2      10.00       0.00                         10.00
       TABELLARIA SP. (72500)                      1 - 2       0.00       0.20                          0.20
    NAVICULACEAE
       NAVICULA CRYPTOCEPHALA (77630)              1 - 2      10.00       0.00                         10.00


          TOTAL FOR  16 SPECIES BY REPLICATE:      1 - 2    2680.        89.

          TOTAL FOR   2 REPLICATES,  16 SPECIES:             2770.
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                                                                                                   PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                      AREA:  CRYSTAL LAKE (24)
STATION:  EQUIDISTANT 3 SPONENKS PNC; DEPTH 3.0M (241)                           DATE:  SEPTEMBER 30, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                 SUBSTATION:    1
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (SC)
NOTE:  NOT APPLICABLE (0)

                                               RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
          GENUS/SPECIES                                  REPLICATES        COUNTS                        TOTAL FOR SP.

CHLOROPHYTA
      VOLVOCALES
          PEDINOMONAS MINUTISSIMA (461)                    1 - 2       0.00      770.00                       770.00
          CHLAMYDOMONAS SPP. (1070)                        1 - 2       0.00       30.00                        30.00
      CHLOROCOCCALES
          SCHROEDERIA SETIGERA (10000)                     1 - 2       0.00      140.00                       140.00
          SPHAEROCYSTIS SCHROETERI (13170)                 1 - 2       0.00      420.00                       430.00
          OOCYSTIS SPP. (15210)                            1 - 2       0.00        0.00                         0.00
          DICTYOSPHAERIUM EHRENBERGIANUM (17260)           1 - 2       0.00      100.00                       100.00
          PEDIASTRUM SPP. (20710)                          1 - 2       1.20        0.00                         1.20
          ELAKATOTHRIX GELATINOSA (21470)                  1 - 2       1.60        0.00                         1.60
      ZYGNEMATALES
          STAURASTRUM GRACILE (31330)                      1 - 2       0.00       20.00                        20.00
          STAURASTRUM PARADOXUM (31340)                    1 - 2      13.30        0.00                        13.30
          STAURASTRUM PROBOSCIDIUM (31350)                 1 - 2       0.30        0.00                         0.30
CRYPTOPHYTA
      CRYPTOMONADACEAE
          CRYPTOMONAS EROSA (47910)                        1 - 2       0.20        0.00                         0.20
          RHODOMONAS MINUTA VAR. NANNOPLANCTICA (48420)    1 - 2       0.00      230.00                       230.00
CHRYSOPHYTA
      PRYMNESIALES
          CHRYSOCHROMULINA PARVA (63130)                   1 - 2       0.00      670.00                       670.00
BACILLARIOPHYCEAE
      NAVICULACEAE
          NAVICULA SPP. (77520)                            1 - 2       0.10        0.00                         0.10
      CYMBELLACEAE
          CYMBELLA SPP. (81500)                            1 - 2       0.10        0.00                         0.10
          CYMBELLA MINUTA (81510)                          1 - 2       0.00       20.00                        20.00
CYANOPHYTA
      NOSTOCALES
          ANABAENA SP. (95020)                             1 - 2       0.30        0.00                         0.30
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                                                                                                        PAGE  2
PROJECT:  ACID RAIN PROJECT (AR)                              AREA:  OYSTER LAKE (24)
STATION:  EQUIDISTANT 3 SHORESAN END; DEPTH 3.0M (241)                                         DATE:  SEPTEMBER 30, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                               SUBSTATION:     1
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  URGS SAMPLING CREW (SC)
NOTE:  NOT APPLICABLE (0)

                                                  RAW DATA TABLES

   1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
         GENUS/SPECIES                                         REPLICATES          COUNTS                          TOTAL FOR SP.

                 TOTAL FOR  18 SPECIES BY REPLICATE:        1 - 2        18.    1970.

                 TOTAL FOR   2 REPLICATES,  18 SPECIES:                1988.
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                                                                                                    PAGE  1

PROJECT:  ACID RAIN PROJECT (RF)                    AREA:  UPPER ISLAND LAKE (25)
STATION:  PICKASIN-NE BASIN, TURK'S BCLY; DEPTH 15.8M (254)                          DATE:  AUGUST 10, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                    SUBSTATION:    4
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (8C)
NOTE:  10 FEET DEEP (11)


                                       RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                  REPLICATES        COUNTS
          GENUS/SPECIES                                                                                TOTAL FOR SP.

  CHLOROPHYTA
      VOLVOCALES
          PEDINOMONAS SP. (460)                            1 - 2     40.00      0.00                        40.00
      CHLOROCOCCALES
          ELAKATOTHRIX GELATINOSA (21470)                  1 - 2     90.00      0.00                        90.00
  CRYPTOPHYTA
      CRYPTOMONADACEAE
          RHODOMONAS MINUTA (48410)                        1 - 2    240.00      0.00                       240.00
  BACILLARIOPHYCEAE
      CENTRALES
          CYCLOTELLA SPP. (84100)                          1 - 2    480.00      0.00                       480.00
      FRAGILARIACEAE
          FRAGILARIA CROTONENSIS (70850)                   1 - 2     30.00      0.00                        30.00
  CYANOPHYTA
      CHROOCOCCALES
          DACTYLOCOCCOPSIS RHAPHIDIOIDES (88520)           1 - 2   5280.00      0.00                      5280.00
      NOSTOCALES
          ANABAENA SP. (95020)                             1 - 2      0.00      4.40                         4.40


              TOTAL FOR   7 SPECIES BY REPLICATE:          1 - 2   6160.       4.

              TOTAL FOR   2 REPLICATES,    7 SPECIES:              6164.
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PROJECT:  ACID RAIN PROJECT (AR)                    AREA:  UPPER ISLAND LAKE (35)                     DATE:  AUGUST 24, 1983
STATION:  PICKASIN-NE BASIN, TURK'S BODY; DEPTH 15.0M (254)                                          SUBSTATION:    4
SAMPLER TYPE:  VAN DORN GRAB (33)
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (SC)
NOTE:  NOT APPLICABLE (0)

                                  RAW DATA TABLES

   1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE
           GENUS/SPECIES                                 REPLICATES           COUNTS                              TOTAL FOR SP.

   CHLOROPHYTA
       VOLVOCALES
           PEDINOMONAS MINUTISSIMA (461)                   1 - 2       0.00      870.00                               870.00
       CHLOROCOCCALES
           SCHROEDERIA SETIGERA (10600)                    1 - 2       0.00       20.00                                20.00
           SPHAEROCYSTIS SCHROETERI (13170)                1 - 2       0.00      540.00                               540.00
           ELAKATOTHRIX GELATINOSA (21470)                 1 - 2       0.00     2230.00                              2230.00
       ZYGNEMATALES
           GONATOZYGON SP. (29260)                         1 - 2       0.10        0.00                                 0.10
   CRYPTOPHYTA
       CRYPTOMONADACEAE
           CRYPTOMONAS EROSA (47910)                       1 - 2       0.00       20.00                                20.00
           RHODOMONAS MINUTA (48410)                       1 - 2       0.00      130.00                               130.00
       KATABLEPHARIDACEAE
           KATABLEPHARIS OVALIS (48780)                    1 - 2       0.00       60.00                                60.00
   CHRYSOPHYTA
       PRYMNESIALES
           CHRYSOCHROMULINA PARVA (63130)                  1 - 2       0.00       10.00                                10.00
   BACILLARIOPHYCEAE
       NITZSCHIACEAE
           NITZSCHIA PALEA (84050)                         1 - 2       0.00       10.00                                10.00
   CYANOPHYTA
       CHROOCOCCALES
           DACTYLOCOCCOPSIS RHAPHIDIOIDES (88520)          1 - 2       0.00      480.00                               480.00

                TOTAL FOR  11 SPECIES BY REPLICATE:        1 - 2       0.    4370.

                TOTAL FOR   2 REPLICATES,  11 SPECIES:           4370.
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                                                                                                   PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)
STATION:  EQUIDISTANT 3 SHORES-NNA COVE;DEPTH 3.5M (251)   AREA:  UPPER ISLAND LAKE (25)        DATE:  AUGUST 27, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                                SUBSTATION:    1
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (UC)
NOTE:  NOT APPLICABLE (0)

                                                   RAW DATA TABLES

   1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
         GENUS/SPECIES                                        REPLICATES          COUNTS                        TOTAL FOR SP.

  CHLOROPHYTA
     CHLOROCOCCALES
        SPHAEROCYSTIS SCHROETERI (13170)
        ELAKATOTHRIX GELATINOSA (21470)                       1 -  2   1300.00      87.00
     OEDOGONIALES                                             1 -  2   5580.00       0.00                        1387.00
        OEDOGONIUM (25300)                                                                                       5580.00
     ZYGNEMATALES                                             1 -  2      0.00       2.40
        STAURASTRUM SPP. (31320)                                                                                    2.40
  PYRRHOPHYTA                                                 1 -  2      0.00       0.30
     DINOKONTAE                                                                                                     0.30
        PERIDINIUM WILLEI (44510)
        PERIDINIUM CINCTUM (44520)                            1 -  2      0.00       0.10
  CRYPTOPHYTA                                                 1 -  2      0.00       0.10                           0.10
     CRYPTOMONADACEAE                                                                                               0.10
        CRYPTOMONAS EROSA (47910)
        RHODOMONAS MINUTA (48410)                             1 -  2     20.00       0.00
  CHRYSOPHYTA                                                 1 -  2    120.00       0.00                          20.00
     PRYMNESIALES                                                                                                 120.00
        CHRYSOCHROMULINA PARVA (63130)
  BACILLARIOPHYCEAE                                           1 -  2    160.00       0.00
     CENTRALES                                                                                                    160.00
        MELOSIRA ISLANDICA (63890)
        CYCLOTELLA SPP. (64100)                               1 -  2      0.00       0.40
     FRAGILARIACEAE                                           1 -  2     40.00       0.00                           0.40
        SYNEDRA SPP. (72110)                                                                                       40.00
        TABELLARIA FLOCCULOSA (72570)                         1 -  2      0.00       0.10
     NITZSCHIACEAE                                            1 -  2      0.00       1.00                           0.10
        NITZSCHIA HOLSATICA (84340)                                                                                 1.00
  CYANOPHYTA                                                  1 -  2      0.00       0.70
     CHAMAESIPHONALES                                                                                               0.70
        LYNGBYA-SP. (91000)
     NOSTOCALES                                               1 -  2      0.00       0.20
        RAPHIDIOPSIS CURVATA (97000)                                                                                0.20
                                                              1 -  2    130.00       0.00
                                                                                                                  130.00
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PROJECT:  ACID RAIN PROJECT (AP)                    AREA:  UPPER ISLAND LAKE (25)                          DATE:  AUGUST 27, 1983
STATION:  EQUIDISTANT 3 SHORES-NNW COVE;DEPTH 3.5M (251)                                                  SUBSTATION:    1
SAMPLER TYPE:  VAN DORN GRAB (33)
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (WC)
NOTE:  NOT APPLICABLE (0)

                                                RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
          GENUS/SPECIES                                              REPLICATES           COUNTS                            TOTAL FOR SP.

                    TOTAL FOR  16 SPECIES BY REPLICATE:          1 - 2    7350.       93.

                    TOTAL FOR   2 REPLICATES,  16 SPECIES:                7443.
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                                                                                                        PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                         AREA:  UPPER ISLAND LAKE (25)                DATE:  AUGUST 27, 1983
STATION:  MIDWAY INFLOW TO ISLAND; DEPTH 3.5M (252)                                                    SUBSTATION:    2
SAMPLER TYPE:  VAN DORN GRAB (33)
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  FRANK MORRIS (65)
NOTE:  1,2,3, M COMPOSITE

                                                    RAW DATA TABLES

   1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE                                      REPLICATES            COUNTS                      TOTAL FOR SP.
           GENUS/SPECIES

   CHLOROPHYTA
       VOLVOCALES
           PEDINOMONAS SP. (460)                                1 -  2      180.00       0.00                       180.00
       CHLOROCOCCALES
           SPHAEROCYSTIS SCHROETERI (13170)                     1 -  2      470.00      44.10                       514.10
           ELAKATOTHRIX GELATINOSA (21470)                      1 -  2     8340.00       0.00                      8340.00
   CRYPTOPHYTA
       CRYPTOMONADACEAE
           CRYPTOMONAS EROSA (47910)                            1 -  2       30.00       0.00                        30.00
           RHODOMONAS MINUTA (48410)                            1 -  2      200.00       0.00                       200.00
   CHRYSOPHYTA
       PRYMNESIALES
           CHRYSOCHROMULINA PARVA (63130)                       1 -  2      320.00       0.00                       320.00
   BACILLARIOPHYCEAE
       CENTRALES
           CYCLOTELLA SPP. (64100)                              1 -  2       20.00       0.00                        20.00
       FRAGILARIACEAE
           FRAGILARIA CROTONENSIS (70850)                       1 -  2       70.00       1.00                        71.00
       CYMBELLACEAE
           CYMBELLA SPP. (81500)                                1 -  2        0.00       0.10                         0.10
   CYANOPHYTA
       OSCILLATORIALES
           OSCILLATORIA SPP. (92000)                            1 -  2        0.00       0.10                         0.10
       NOSTOCALES
           RAPHIDIOPSIS CURVATA (97000)                         1 -  2      130.00       0.00                       130.00


               TOTAL FOR  11 SPECIES BY REPLICATE:              1 -  2     9760.        45.

               TOTAL FOR   2 REPLICATES,  11 SPECIES:                      9805.
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PROJECT: ACID RAIN PROJECT (AR)                  AREA: UPPER ISLAND LAKE (25)
STATION: MIDWAY ISLAND TO 2ND PT.-SW SHORE; DEPTH 7.3M (253)                            DATE: AUGUST 27, 1983
SAMPLER TYPE: VAN DORN GRAB (33)                                                        SUBSTATION:    3
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST: USGS SAMPLING CREW (SC)
NOTE: NOT APPLICABLE (0)

                                                 RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                  REPLICATES          COUNTS                          TOTAL FOR SP.
          GENUS/SPECIES

CHLOROPHYTA
      VOLVOCALES
          PROTHOMONAS SP. (460)                            1 - 2       0.00      10.00                          10.00
      CHLOROCOCCALES
          SCHROEDERIA SETIGERA (10600)                     1 - 2       0.00     280.00                         280.00
          TETRAEDRON REGULARE VAR. GRANULATA (11930)       1 - 2       0.10       0.00                           0.10
          SPHAEROCYSTIS SCHROETERI (13170)                 1 - 2      60.30       0.00                          60.30
          ELAKATOTHRIX GELATINOSA (21470)                  1 - 2       0.00    5690.00                        5690.00
      ZYGNEMATALES
          STAURASTRUM GRACILE (31330)                      1 - 2       0.20       0.00                           0.20
CRYPTOPHYTA
      CRYPTOMONADACEAE
          CRYPTOMONAS EROSA (47910)                        1 - 2       0.00      20.00                          20.00
          RHODOMONAS MINUTA (48410)                        1 - 2       0.00      80.00                          80.00
CHRYSOPHYTA
      PRYMNESIALES
          CHRYSOCHROMULINA PARVA (63130)                   1 - 2       0.00      50.00                          50.00
BACILLARIOPHYCEAE
      FRAGILARIACEAE
          ASTERIONELLA FORMOSA (68550)                     1 - 2       0.10       0.00                           0.10
      NAVICULACEAE
          NAVICULA PUPULA (77590)                          1 - 2       0.20       0.00                           0.20
          PINNULARIA BOREALIS (78830)                      1 - 2       0.10       0.00                           0.10
      CYMBELLACEAE
          CYMBELLA SPP. (81900)                            1 - 2       0.20       0.00                           0.20
      NITZSCHIACEAE
          NITZSCHIA SPP. (84000)                           1 - 2       0.40       0.00                           0.40
CYANOPHYTA
      NOSTOCALES
          ANABAENA SP. (95020)                             1 - 2       0.00      40.00                          40.00
          RAPHIDIOPSIS CURVATA (97000)                     1 - 2       0.00      70.00                          70.00
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PROJECT:  ACID RAIN PROJECT (AR)                              AREA:  UPPER ISLAND LAKE (25)
STATION:  MIDWAY ISLAND TO 2ND PT.-SW SHORE; DEPTH 7.3M (253)                                     DATE:  AUGUST 27, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                                  SUBSTATION:    3
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (SC)
NOTE:  NOT APPLICABLE (0)

                                              RAW DATA TABLES

   1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
         GENUS/SPECIES                                   REPLICATES          COUNTS                          TOTAL FOR SP.

               TOTAL FOR  16 SPECIES BY REPLICATE:        1 - 2       62.    6240.

               TOTAL FOR   2 REPLICATES,  16 SPECIES:              6302.
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                                                                                                    PAGE  1
PROJECT:  ACID RAIN PROJECT (AP)                          AREA:  UPPER ISLAND LAKE (25)
STATION:  MIDBASIN-NE BASIN, TURK'S BODY; DEPTH 15.0M (254)                                 DATE:  AUGUST 27, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                           SUBSTATION:    4
NUMBER OF REPLICATES:    2     FIELD BIOLOGIST:  FRANK MORRIS (65)
NOTE:  10,5,1 M COMPOSITE (16)

                                                       RAW DATA TABLES

     1ST LEVEL REFERENCE
          2ND LEVEL REFERENCE                                REPLICATES          COUNTS                        TOTAL FOR SP.
               GENUS/SPECIES

     CHLOROPHYTA
          VOLVOCALES
               PEDINOMONAS SP. (460)                          1 - 2      40.00       0.00                          40.00
          CHLOROCOCCALES
               SCHROEDERIA SETIGERA (10600)                   1 - 2     600.00       0.00                         600.00
               SPHAEROCYSTIS SCHROETERI (13170)               1 - 2     280.00      63.80                         343.80
               ELAKATOTHRIX GELATINOSA (21470)                1 - 2    2760.00       0.00                        2760.00
          ZYGNEMATALES
               COSMARIUM BIOCULATUM FA. DEPRESSA (29350)      1 - 2       0.00       0.20                           0.20
               STAURASTRUM GRACILE (35330)                    1 - 2      10.00       1.50                          11.50
     CRYPTOPHYTA
          CRYPTOMONADACEAE
               CRYPTOMONAS EROSA (47910)                      1 - 2      20.00       0.00                          20.00
               RHODOMONAS MINUTA (48410)                      1 - 2     310.00       0.00                         310.00
     BACILLARIOPHYCEAE
          FRAGILARIACEAE
               FRAGILARIA CROTONENSIS (70850)                 1 - 2       0.00       1.10                           1.10
     CYANOPHYTA
          NOSTOCALES
               RAPHIDIOPSIS SP. (97010)                       1 - 2     120.00       0.00                         120.00


                  TOTAL FOR  10 SPECIES BY REPLICATE:         1 - 2    4140.      67.

                  TOTAL FOR   2 REPLICATES,  10 SPECIES:               4207.
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                                                                                                          PAGE  1
PROJECT:  ACID RAIN PROJECT (AP)                          AREA:  UPPER ISLAND LAKE (25)
STATION:  MIDBASIN-NE BASIN, TURK'S BUOY; DEPTH 15.8M (254)                                      DATE:  AUGUST 27, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                                 SUBSTATION:     4
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (8C)
NOTE:  1 M DEEP DISCRETE (12)


                                                 RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                    REPLICATES           COUNTS
          GENUS/SPECIES                                                                                    TOTAL FOR SP.

  CHLOROPHYTA
      VOLVOCALES
          PEDINOMONAS SP. (460)                              1 -  2        0.00      80.00                       80.00
      CHLOROCOCCALES
          SPHAEROCYSTIS SCHROETERI (13170)                   1 -  2       86.50     300.00                      386.50
          DICTYOSPHAERIUM EHRENBERGIANUM (17260)             1 -  2        2.80       0.00                        2.80
          ELAKATOTHRIX GELATINOSA (21470)                    1 -  2        0.00    8700.00                     8700.00
      ZYGNEMATALES
          GONATOZYGON SP. (29200)                            1 -  2        0.10       0.00                        0.10
          STAURASTRUM GRACILE (31330)                        1 -  2        0.50       0.00                        0.50
          STAURASTRUM PROBOSCIDIUM (31350)                   1 -  2        0.10       0.00                        0.10
  CRYPTOPHYTA
      CRYPTOMONADACEAE
          CRYPTOMONAS EROSA (47910)                          1 -  2        0.00      60.00                       60.00
          RHODOMONAS MINUTA (48410)                          1 -  2        0.00     120.00                      120.00
  CHRYSOPHYTA
      PRYMNESIALES
          CHRYSOCHROMULINA PARVA (63130)                     1 -  2        0.00     140.00                      140.00
  BACILLARIOPHYCEAE
      FRAGILARIACEAE
          FRAGILARIA CROTONENSIS (70850)                     1 -  2        0.40       0.00                        0.40
          FRAGILARIA BREVISTRIATA (70900)                    1 -  2        0.50       0.00                        0.50
          OPEPHORA SP. (73130)                               1 -  2        0.00      20.00                       20.00
  CYANOPHYTA
      OSCILLATORIALES
          OSCILLATORIA SPP. (92000)                          1 -  2        0.10       0.00                        0.10
      NOSTOCALES
          ANABAENA SP. (95020)                               1 -  2        6.00       0.00                        6.00
          RAPHIDIOPSIS CURVATA (97000)                       1 -  2        0.00      16.00                       16.00
                -

              TOTAL FOR  16 SPECIES BY REPLICATE:            1 -  2       97.     9436.

              TOTAL FOR   2 REPLICATES,  16 SPECIES:                    9533.
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                                                                                              PAGE  1

PROJECT:  ACID RAIN PROJECT (AR)                       AREA:  UPPER ISLAND LAKE (25)
STATION:  MICRABIN-NE BASIN, TURK'S HOLE; DEPTH 15.0M (254)                         DATE:  AUGUST 27, 1987
SAMPLER TYPE:  VAN DORN GRAB (33)                                                    SUBSTATION:      4
NUMBER OF REPLICATES:    2     FIELD BIOLOGIST:  FRANK MORRIS (65)
NOTE:  5 M DISCRETE (14)

                                                  RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                  REPLICATES          COUNTS                             TOTAL FOR SP.
          GENUS/SPECIES

  CHLOROPHYTA
      VOLVOCALES
          PEDINOMONAS MINUTISSIMA (461)                     1 -  2      0.00      580.00                            580.00
      CHLOROCOCCALES
          SPHAEROCYSTIS SCHROETERI (13170)                  1 -  2    151.50     1520.00                           1671.50
          ELAKATOTHRIX GELATINOSA (21470)                   1 -  2      0.00      656.00                            656.00
      ZYGNEMATALES
          COSMARIUM SPP. (29320)                            1 -  2      0.10        0.00                              0.10
          STAURASTRUM GRACILE (31330)                       1 -  2      0.10        0.00                              0.10
  CRYPTOPHYTA
      CRYPTOMONADACEAE
          CRYPTOMONAS EROSA (47910)                         1 -  2      0.40        0.00                              0.40
          RHODOMONAS MINUTA (48410)                         1 -  2      0.00      120.00                            120.00
  CHRYSOPHYTA
      PRYMNESIALES
          CHRYSOCHROMULINA PARVA (63130)                    1 -  2      1.50       80.00                             81.50
  BACILLARIOPHYCEAE
      FRAGILARIACEAE
          FRAGILARIA CROTONENSIS (70850)                    1 -  2      1.10        0.00                              1.10
          FRAGILARIA BREVISTRIATA (70900)                   1 -  2      0.10        0.00                              0.10
          TABELLARIA FLOCCULOSA (72570)                     1 -  2      0.50        0.00                              0.50
      NAVICULACEAE
          NEIDIUM IRIDIS FA. VERNALIS (78560)               1 -  2      0.10        0.00                              0.10
  CYANOPHYTA
      OSCILLATORIALES
          OSCILLATORIA SPP. (92000)                         1 -  2      0.10        0.00                              0.10
      NOSTOCALES
          RAPHIDIOPSIS CURVATA (97000)                      1 -  2      0.00      220.00                            220.00


                 TOTAL FOR  14 SPECIES BY REPLICATE:        1 -  2      156.     3176.

                 TOTAL FOR   2 REPLICATES,  14 SPECIES:               3332.
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PROJECT:  ACID RAIN PROJECT (AR)                    AREA:  UPPER ISLAND LAKE (29)
STATION:  PICBARIN-NE BASIN, TURK'S HOLY; DEPTH 15.0M (254)                              DATE:  AUGUST 27, 1983
SAMPLER TYPE:  VAN CORN GRAB (33)                                                         SUBSTATION:    4
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  FRANK MORRIS (69)
NOTE:  10 M DISCRETE (15)

                                             RAW DATA TABLES

  1ST LEVEL REFERENCE
     2ND LEVEL REFERENCE
          GENUS/SPECIES                                   REPLICATES          COUNTS                       TOTAL FOR SP.

  CHLOROPHYTA
     VOLVOCALES
          PEDINOMONAS SP. (460)                            1 - 2        0.00        0.10
     CHLOROCOCCALES                                                                                                0.10
          SCHROEDERIA SETIGERA (10600)                     1 - 2       20.00        0.00
          SPHAEROCYSTIS SCHROETERI (13170)                 1 - 2      900.00        0.10                          20.00
          ELAKATOTHRIX GELATINOSA (21470)                  1 - 2     3360.00        0.00                         900.10
     OEDOGONIALES                                                                                               3360.00
          OEDOGONIUM (25300)                               1 - 2        0.00        5.60
     ZYGNEMATALES                                                                                                  5.60
          STAURASTRUM GRACILE (31330)                      1 - 2        0.00        1.60
  CRYPTOPHYTA                                                                                                      1.60
     CRYPTOMONADACEAE
          RHODOMONAS MINUTA (48410)                        1 - 2      280.00        0.00
  CHRYSOPHYTA                                                                                                    280.00
     PRYMNESIALES
          CHRYSOCHROMULINA PARVA (63130)                   1 - 2      120.00        0.00
  BACILLARIOPHYCEAE                                                                                              120.00
     CENTRALES
          CYCLOTELLA STELLIGERA (64130)                    1 - 2       60.00        0.00
  CYANOPHYTA                                                                                                      60.00
     OSCILLATORIALES
          OSCILLATORIA SPP. (92000)                        1 - 2        0.00        0.20
     NOSTOCALES                                                                                                    0.20
          RAPHIDIOPSIS CURVATA (97000)                     1 - 2      140.00        0.00
                                                                                                                 140.00

                TOTAL FOR  11 SPECIES BY REPLICATE:        1 - 2     4880.        8.

                TOTAL FOR   2 REPLICATES,  11 SPECIES:               4888.
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                                                                                                    PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                               AREA:  UPPER ISLAND LAKE (25)
STATION:  PICRASIN-KE BASIN, TURK'S BOLT; DEPTH 19.8M (254)                               DATE:  SEPTEMBER  8, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                          SUBSTATION:    4
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  USGS SAMPLING CREW (80)
NOTE:  NOT APPLICABLE (0)

                                                  RAW DATA TABLES

   1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE
            GENUS/SPECIES                                     REPLICATES          COUNTS                          TOTAL FOR SP.

   CHLOROPHYTA
       VOLVOCALES
            PROCINOMONAS MINUTISSIMA (461)                   1 -  2     240.00       0.00                               240.00
       CHLOROCOCCALES
            SCHROEDERIA SETIGERA (10600)                     1 -  2      90.00       0.00                                90.00
            SPHAEROCYSTIS SCHROETERI (13170)                 1 -  2      80.00       0.00                                80.00
            KIRCHNERIELLA SPP. (14880)                       1 -  2      50.00       0.00                                50.00
            DICTYOSPHAERIUM EHRENBERGIANUM (17260)           1 -  2       0.00      17.40                                17.40
            ELAKATOTHRIX GELATINOSA (21470)                  1 -  2   14990.00       0.00                             14990.00
       OEDOGONIALES
            OEDOGONIUM (25300)                               1 -  2       0.00       0.10                                 0.10
       ZYGNEMATALES
            COSMARIUM SPP. (29370)                           1 -  2       0.00       0.20                                 0.20
   CRYPTOPHYTA
       CRYPTOMONADACEAE
            CRYPTOMONAS EROSA (47910)                        1 -  2      10.00       0.00                                10.00
            RHODOMONAS MINUTA (48410)                        1 -  2     120.00       0.00                               120.00
       KATABLEPHARIDACEAE
            KATABLEPHARIS OVALIS (48780)                     1 -  2     170.00       0.00                               170.00
   CHRYSOPHYTA
       OCHROMONADALES
            OCHROMONAS SPP. (58130)                          1 -  2      10.00       0.00                                10.00
       PRYMNESIALES
            CHRYSOCHROMULINA PARVA (63130)                   1 -  2     480.00       0.00                               480.00
   BACILLARIOPHYCEAE
       NAVICULACEAE
            NAVICULA SPP. (77520)                            1 -  2      10.00       0.00                                10.00
       CYMBELLACEAE
            CYMBELLA SPP. (81900)                            1 -  2      20.00       0.00                                20.00
       NITZSCHIACEAE
            NITZSCHIA SPP. (84000)                           1 -  2      10.00       0.00                                10.00
   CYANOPHYTA
       NOSTOCCALES
            ANABAENA SP. (95020)                             1 -  2     160.00       7.10                               167.10
```

```
PROJECT:  ACID RAIN PROJECT (AR)                    AREA:  UPPER INLAND LAKE (25)
STATION:  PICKABIN-NE BASIN, TURK'S BCLY; DEPTH 15.0M (354)                              DATE:  SEPTEMBER  8, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                         SUBSTATION:    4
NUMBER OF REPLICATES:   2     FIELD PERSONNEL:  UNCA SAMPLING CREW (80)
NOTE:  NOT APPLICABLE (0)

                                      RAW DATA TABLES

   1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
         GENUS/SPECIES                                  REPLICATES         COUNTS                    TOTAL FOR SP.

               TOTAL FOR  17 SPECIES BY REPLICATE:      1 -  2   18616.      20.

               TOTAL FOR   2 REPLICATES,  17 SPECIES:            18636.
```

```
PROJECT:  ACID RAIN PROJECT (AR)                       AREA:  UPPER ISLAND LAKE (25)
STATION:  MIDBASIN-NE BASIN, TURK'S POLY; DEPTH 15.8M (254)                          DATE:  SEPTEMBER 21, 1983
SAMPLER TYPE:  VAN DORN GRAB (33)                                                    SUBSTATION:    4
NUMBER OF REPLICATES:   2    FIELD BIOLOGIST:  USGS SAMPLING CREW (8C)
NOTE:  NOT APPLICABLE (0)

                                     RAW DATA TABLES

  1ST LEVEL REFERENCE
     2ND LEVEL REFERENCE
        GENUS/SPECIES                                  REPLICATES         COUNTS                        TOTAL FOR SP.

 CHLOROPHYTA
    VOLVOCALES
        PEDINOMONAS MINUTISSIMA (461)                    1 - 2      0.00    170.00
    CHLOROCOCCALES                                                                                         170.00
        SCHROEDERIA SETIGERA (10600)                     1 - 2      0.00     20.00
        SPHAEROCYSTIS SCHROETERI (13170)                 1 - 2      0.00    420.00                          20.00
        SELENASTRUM MINUTUM (16020)                      1 - 2      0.00     50.00                         420.00
        DICTYOSPHAERIUM EHRENBERGIANUM (17260)           1 - 2      0.00    430.00                          50.00
        ELAKATOTHRIX GELATINOSA (21470)                  1 - 2      0.00   7720.00                         430.00
    ZYGNEMATALES                                                                                          7720.00
        GONATOZYGON MONOTAENIUM (29210)                  1 - 2      0.40     10.00
        STAURASTRUM PARADOXUM (31340)                    1 - 2      0.20      0.00                          10.40
 PYRRHOPHYTA                                                                                                 0.20
    DINOPHYCEAE
        PERIDINIUM CINCTUM (44520)                       1 - 2      0.60      0.00
 CRYPTOPHYTA                                                                                                 0.60
    CRYPTOMONADACEAE
        CRYPTOMONAS EROSA (47910)                        1 - 2      0.00     20.00
        RHODOMONAS MINUTA VAR. NANNOPLANCTICA (48420)    1 - 2      0.00     10.00                          20.00
 CHRYSOPHYTA                                                                                                10.00
    PRYMNESIALES
        CHRYSOCHROMULINA PARVA (63130)                   1 - 2      0.00    660.00
 BACILLARIOPHYCEAE                                                                                         660.00
    GOMPHONEMACEAE
        GOMPHONEMA GIBBA (80650)                         1 - 2      0.00     10.00
    CYMBELLACEAE                                                                                            10.00
        CYMBELLA MINUTA (81510)                          1 - 2      0.00     10.00
    NITZSCHIACEAE                                                                                           10.00
        NITZSCHIA SPP. (84000)                           1 - 2      0.00     20.00
                                                                                                            20.00

                 TOTAL FOR  15 SPECIES BY REPLICATE:     1 - 2      1.   9550.

                 TOTAL FOR   2 REPLICATES,  15 SPECIES:                9551.
```

APPENDIX C. ZOOPLANKTON COUNTS FROM FLAT TOPS LAKES SURVEYED DURING 1983.

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                                                                                              PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                               AREA:  NED WILSON LAKE (23)
STATION:  EQUIDISTANT  3 SHORES-BE COVE; DEPTH 4.3M (231)                          DATE:  AUGUST 29, 1983
SAMPLER TYPE:  DC MICRO WISCONSIN NET VERTICAL TOW 3.5 M (76)                       SUBSTATION:     C
NUMBER OF REPLICATES:   3      FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NUMBER/M2 X 1000 (6)

                                                    RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
          GENUS/SPECIES                                 REPLICATES         COUNTS                      TOTAL FOR SP.

  CLADOCERA
      HOLOPEDIDAE
          HOLOPEDIUM GIBBERUM (31722)
  COPEPODA                                               1 - 3      8.       5.      12.
                                                                                                          25.

          NAUPLIUS (36020)
          COPEPODITE DIAPTOMUS (36035)                   1 - 3     90.      96.      66.                 252.
      CALANOIDA                                          1 - 3      5.      13.      12.                  30.
          DIAPTOMUS COLORADENSIS (37059)
  ROTIFERA                                               1 - 3     21.      26.      26.
      BRACHIONIDAE                                                                                        73.
          KERATELLA COCHLEARIS (54270)
      SYNCHAETIDAE                                       1 - 3   1001.    1209.     488.
          POLYARTHRA SPP. (55760)                                                                       2698.
      CONOCHILIDAE                                       1 - 3      4.       4.       7.
          CONOCHILUS UNICORNIS (58463)                                                                    15.
                                                         1 - 3    410.     543.     424.
                                                                                                        1377.


              TOTAL FOR   7 SPECIES BY REPLICATE:        1 - 3   1539.    1896.    1035.

              TOTAL FOR   3 REPLICATES,   7 SPECIES:             4470.
```

```
PROJECT:  ACID RAIN PROJECT (AR)                      AREA:  NED WILSON LAKE (23)                     DATE:  AUGUST 29, 1983
STATION:  BIGLAKE, TURK'S BOUY; DEPTH  9.3M  (232)                                                     SUBSTATION:   C
SAMPLER TYPE:  OC PICNC WISCONSIN NET VERTICAL TOW 4.5 M (77)
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NUMBER/M3 X 1000 (6)

                                       RAW DATA TABLES

 1ST LEVEL REFERENCE
     2ND LEVEL REFERENCE
          GENUS/SPECIES                             REPLICATES         COUNTS                           TOTAL FOR SP.

 CLADOCERA
     HOLOPEDIDAE
          HOLOPEDIUM GIBBERUM (31722)                1 - 3      12.       8.        1.                        21.
 COPEPODA

          NAUPLIUS (36020)                           1 - 3     108.     117.      116.                       341.
          COPEPODITE DIAPTOMUS (36035)               1 - 3      30.      42.       28.                       100.
     CALANOIDA
          DIAPTOMUS COLORADENSIS (37059)             1 - 3      28.      22.       27.                        77.
 ROTIFERA
     BRACHIONIDAE
          KERATELLA COCHLEARIS (54270)               1 - 3    1233.    1491.     1583.                      4307.
     SYNCHAETIDAE
          POLYARTHRA SPP. (55760)                    1 - 3       1.      14.        6.                        21.
     CONOCHILIDAE
          CONOCHILUS UNICORNIS (56463)               1 - 3     555.     527.      464.                      1546.


               TOTAL FOR   7 SPECIES BY REPLICATE:   1 - 3    1967.    2221.     2225.

               TOTAL FOR   3 REPLICATES,   7 SPECIES:         6413.
```

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                                                                                                    PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                    AREA:  NED WILSON LAKE (23)                    DATE:  AUGUST 25, 1983
STATION:  EQUIDISTANT 3 SHORES-N COVE;  DEPTH 2.5M )(233)                                          SUBSTATION:    C
SAMPLER TYPE:  80 MICRO WISCONSIN NET VERTICAL TOW 2.0 M (73)
NUMBER OF REPLICATES:   3      FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NUMBER/M2 X 1000 (6)

                                                 RAW DATA TABLES

   1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                 REPLICATES           COUNTS                        TOTAL FOR SP.
         GENUS/SPECIES

   CLADOCERA
      HOLOPEDIDAE
         HOLOPEDIUM GIBBERUM (31722)                        1 - 3        3.       6.       4.                         13.
   COPEPODA

         NAUPLIUS (36020)                                   1 - 3       64.      83.      91.                        238.
         COPEPODITE DIAPTOMUS (36035)                       1 - 3       22.      12.      20.                         54.
      CALANOIDA
         DIAPTOMUS COLORADENSIS (37059)                     1 - 3        3.      19.      20.                         42.
   ROTIFERA
      BRACHIONIDAE
         KERATELLA COCHLEARIS (54270)                       1 - 3      798.     965.    1572.                       3335.
      SYNCHAETIDAE
         POLYARTHRA SPP. (55760)                            1 - 3        5.       9.       1.                         15.
      CONOCHILIDAE
         CONOCHILUS UNICORNUS (56463)                       1 - 3      777.     808.     569.                       2154.


                TOTAL FOR   7 SPECIES BY REPLICATE:         1 - 3     1672.    1902.    2277.

                TOTAL FOR   3 REPLICATES,   7 SPECIES:                5851.
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                                                                                                    PAGE  1

PROJECT:  ACID RAIN PROJECT (AP)                          AREA:  NED WILSON LAKE (23)                DATE:  AUGUST 25, 1983
STATION:  100M OFFSHORE-W SHALLOW COVE; DEPTH 5.0M (234)                                              SUBSTATION:    0
SAMPLER TYPE:  80 MICRO WISCONSIN NET VERTICAL TOW 4.5 M (77)
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NUMBER/M2 X 1000 (6)

                                              RAW DATA TABLES

   1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                     REPLICATES          COUNTS                     TOTAL FOR SP.
         GENUS/SPECIES

   CLADOCERA
      HOLOPEDIDAE
         HOLOPEDIUM GIBBERUM (31722)                          1 - 3      12.      22.      15.                        49.
      DAPHNIIDAE
         DAPHNIA PULEX (31790)                                1 - 3       0.       0.       1.                         1.
   COPEPODA

         NAUPLIUS (36020)                                     1 - 3     148.     182.     105.                       435.
         COPEPODITE DIAPTOMUS (36035)                         1 - 3      13.      10.       8.                        31.
      CALANOIDA
         DIAPTOMUS COLORADENSIS (37059)                       1 - 3      26.      31.      35.                        92.
   ROTIFERA
      BRACHIONIDAE
         KERATELLA COCHLEARIS (54270)                         1 - 3    1448.    1864.    1552.                      4864.
      SYNCHAETIDAE
         POLYARTHRA SPP. (55760)                              1 - 3       3.      12.       9.                        24.
      CONOCHILIDAE
         CONOCHILUS UNICORNUS (56463)                         1 - 3     170.     390.     267.                       827.


               TOTAL FOR   8 SPECIES BY REPLICATE:            1 - 3    1820.    2511.    1992.

               TOTAL FOR   3 REPLICATES,   8 SPECIES:                  6323.
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                                                                                                    PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                          AREA:  OYSTER LAKE (24)
STATION:  EQUIDISTANT 3 SHORES, END; DEPTH 3.0M (241)                                       DATE:  AUGUST 23, 1983
SAMPLER TYPE:  80 MICRO WISCONSIN NET VERTICAL TOW 3.5 M (76)                               SUBSTATION:    U
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NUMBER/M2 X 1000 (6)

                                                   RAW DATA TABLES

   1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE
           GENUS/SPECIES                                     REPLICATES            COUNTS                         TOTAL FOR SP.

   CLADOCERA
       DAPHNIIDAE
           DAPHNIA PULEX (31790)
   COPEPODA                                                   1 - 3        8.         6.         8.                        22.

           NAUPLIUS (36020)
           COPEPODITE DIAPTOMUS (36035)                       1 - 3       98.       157.       140.                       395.
       CALANOIDA                                              1 - 3       35.        55.        40.                       130.
           DIAPTOMUS COLORADENSIS (37059)
           DIAPTOMUS SHOSHONE (37061)                         1 - 3        5.         8.        15.                        28.
   AMPHIPODA                                                  1 - 3        1.         0.         0.                         1.
       TALITRIDAE
           HYALELLA AZTECA (41060)
   ROTIFERA                                                   1 - 3        1.         0.         0.                         1.
       BRACHIONIDAE
           KERATELLA COCHLEARIS (54270)
       SYNCHAETIDAE                                           1 - 3       85.       134.       107.                       326.
           POLYARTHRA SPP. (55760)
       CONOCHILIDAE                                           1 - 3        1.         2.         0.                         3.
           CONOCHILUS UNICORNUS (56463)
                                                              1 - 3       48.        57.        17.                       122.


               TOTAL FOR   9 SPECIES BY REPLICATE:           1 - 3      282.       419.       327.

               TOTAL FOR   3 REPLICATES,   9 SPECIES:                  1028.
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                                                                                                      PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                        AREA:  OYSTER LAKE (24)
STATION:  EQUIDISTANT 3 SHORES-ESE COVE; DEPTH 3.5M (242)                                        DATE:  AUGUST 23, 1983
SAMPLER TYPE:  80 MICRO WISCONSIN NET VERTICAL TOW 2.0 M (73)                                   SUBSTATION:    C
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NUMBER/M2 X 1000 (6)

                                              RAW DATA TABLES

  1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE
            GENUS/SPECIES                                  REPLICATES          COUNTS                          TOTAL FOR SP.

  CLADOCERA
       DAPHNIIDAE
            DAPHNIA PULEX (31790)                          1 -  3        2.        6.        4.                       12.
  COPEPODA

            NAUPLIUS (36020)                               1 -  3      217.      248.      263.                      728.
            COPEPODITE DIAPTOMUS (36035)                   1 -  3       35.       55.       71.                      161.
       CALANOIDA
            DIAPTOMUS COLORADENSIS (37059)                 1 -  3       12.       12.       12.                       36.
            DIAPTOMUS SHOSHONE (37061)                     1 -  3        0.        1.        1.                        2.
  AMPHIPODA
       TALITRIDAE
            HYALELLA AZTECA (41060)                        1 -  3        0.        0.        1.                        1.
  ROTIFERA
       BRACHIONIDAE
            KERATELLA COCHLEARIS (54270)                   1 -  3      188.      237.      303.                      728.
       SYNCHAETIDAE
            POLYARTHRA SPP. (55760)                        1 -  3        3.        1.        0.                        4.
       CONOCHILIDAE
            CONOCHILUS UNICORNIS (56463)                   1 -  3       33.       55.       38.                      126.


                 TOTAL FOR   9 SPECIES BY REPLICATE:       1 -  3      490.      615.      693.

                 TOTAL FOR   3 REPLICATES,   9 SPECIES:           1798.
```

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PROJECT: ACID RAIN PROJECT (AR)                  AREA: UPPER ISLAND LAKE (25)                    DATE: AUGUST 27, 1983
STATION: EQUIDISTANT 3 SHORES-NNW COVE;DEPTH 3.5M (251)                                          SUBSTATION:    0
SAMPLER TYPE: 8C MICRO WISCONSIN NET VERTICAL TOW 3.0 M (75)
NUMBER OF REPLICATES:   3    FIELD BIOLOGIST: BARRY BALDIGO (21)
NOTE: NUMBER/M2 X 1000 (6)

                                             RAW DATA TABLES

 1ST LEVEL REFERENCE
    2ND LEVEL REFERENCE
       GENUS/SPECIES                                   REPLICATES          COUNTS                         TOTAL FOR SP.

 CLADOCERA
    DAPHNIDAE
       CERIODAPHNIA QUADRANGULA (32075)                  1 - 3       2.       7.       5.                    14.
 COPEPODA

       NAUPLIUS (36020)                                  1 - 3       2.       1.       0.                     3.
       COPEPODITE DIAPTOMUS (36035)                      1 - 3       0.       0.       1.                     1.
    CALANOIDA
       DIAPTOMUS ARAPAHOENSIS (37060)                    1 - 3       2.       1.       2.                     5.
 ROTIFERA
    BRACHIONIDAE
       KERATELLA COCHLEARIS (54270)                      1 - 3       0.       1.       5.                     6.
       KERATELLA QUADRATA (54300)                        1 - 3       0.       1.       0.                     1.
    SYNCHAETIDAE
       POLYARTHRA SPP. (55760)                           1 - 3       2.       6.       8.                    16.
    CONOCHILIDAE
       CONOCHILUS UNICORNUS (56463)                      1 - 3      15.      22.      49.                    86.


              TOTAL FOR   8 SPECIES BY REPLICATE:        1 - 3      23.      39.      70.

              TOTAL FOR   3 REPLICATES,   8 SPECIES:               132.
```

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                                                                                              PAGE  1
PROJECT:  ACID RAIN PROJECT (AP)                        AREA:  UPPER ISLAND LAKE (25)
STATION:  MIDWAY INFLOW TO ISLAND; DEPTH 3.5M (252)                                          DATE:  AUGUST 27, 1983
SAMPLER TYPE:  OC MICRO WISCONSIN NET VERTICAL TOW 3.0 M (75)                                SUBSTATION:    0
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NUMBER/M2 X 1000 (6)

                                                 RAW DATA TABLES

   1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
         GENUS/SPECIES                            REPLICATES         COUNTS                          TOTAL FOR SP.

   CLADOCERA
      DAPHNIDAE
         DAPHNIA ROSEA (31765)                      1 - 3      0.       1.       0.                              1.
         CERIODAPHNIA QUADRANGULA (32075)           1 - 3      7.      11.      21.                             39.
      CHYDORIDAE
         CHYDORUS SPHAERICUS (33280)                1 - 3      0.       0.       1.                              1.
   COPEPODA

         NAUPLIUS (36020)                           1 - 3      1.       0.       1.                              2.
         COPEPODITE DIAPTOMUS (36035)               1 - 3      1.       1.       0.                              2.
      CALANOIDA
         DIAPTOMUS ARAPAHOENSIS (37060)             1 - 3      6.      12.      13.                             31.
   ROTIFERA
      BRACHIONIDAE
         KERATELLA COCHLEARIS (54270)               1 - 3      9.      21.      11.                             41.
         KERATELLA QUADRATA (54300)                 1 - 3      0.       0.       1.                              1.
      SYNCHAETIDAE
         POLYARTHRA SPP. (55760)                    1 - 3     42.     102.      52.                            196.
      CONOCHILIDAE
         CONOCHILUS UNICORNUS (56463)               1 - 3     60.     203.     122.                            385.


              TOTAL FOR  10 SPECIES BY REPLICATE:   1 - 3    126.     351.     222.

              TOTAL FOR   3 REPLICATES,  10 SPECIES:         699.
```

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                                                                                                   PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                         AREA:  UPPER ISLAND LAKE (25)                      DATE:  AUGUST 27, 1983
STATION:  MIDWAY ISLAND TO 2ND PT.-SW SHORE; DEPTH 7.3M (253)                                               SUBSTATION:     0
SAMPLER TYPE:  80 MICRO WISCONSIN NET VERTICAL TOW 6.0 M (78)
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NUMBER/M2 X 1000 (6)

                                                    RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
          GENUS/SPECIES                                       REPLICATES          COUNTS                      TOTAL FOR SP.

  CLADOCERA
      DAPHNIIDAE
          DAPHNIA ROSEA (31765)                                 1 - 3      1.      2.      4.                        7.
          CERIODAPHNIA QUADRANGULA (32075)                      1 - 3     28.     15.     29.                       72.
  COPEPODA

          NAUPLIUS (36020)                                      1 - 3      2.      1.      5.                        8.
          COPEPODITE DIAPTOMUS (36035)                          1 - 3      1.      2.      0.                        3.
      CALANOIDA
          DIAPTOMUS ARAPAHOENSIS (37060)                        1 - 3     27.     20.     20.                       67.
  ROTIFERA
      BRACHIONIDAE
          KERATELLA COCHLEARIS (54270)                          1 - 3     20.     12.     23.                       55.
          KERATELLA QUADRATA (54300)                            1 - 3      1.      0.      0.                        1.
      SYNCHAETIDAE
          POLYARTHRA SPP. (55760)                               1 - 3     94.     51.     92.                      237.
      CONOCHILIDAE
          CONOCHILUS UNICORNUS (56463)                          1 - 3     84.     48.     87.                      219.


               TOTAL FOR   9 SPECIES BY REPLICATE:              1 - 3    258.    151.    260.

               TOTAL FOR   3 REPLICATES,   9 SPECIES:                    669.
```

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                                                                                                          PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                        AREA:  UPPER ISLAND LAKE (25)
STATION:  MIDBASIN-NE BASIN, TURK'S BODY; DEPTH 15.8M (254)                                    DATE:  AUGUST 26, 1983
SAMPLER TYPE:  80 MICRO WISCONSIN NET VERTICAL TOW 14.0 M (79)                                  SUBSTATION:    0
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NUMBER/M2 X 1000 (6)

                                              RAW DATA TABLES

   1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE
           GENUS/SPECIES                                  REPLICATES          COUNTS                          TOTAL FOR SP.

   CLADOCERA
       DAPHNIDAE
           DAPHNIA ROSEA (31765)                           1 - 3      19.       8.       3.                       30.
           CERIODAPHNIA QUADRANGULA (32075)                1 - 3      87.      88.      93.                      268.
   COPEPODA
           NAUPLIUS (36020)                                1 - 3      19.      32.       6.                       57.
           COPEPODITE DIAPTOMUS (36035)                    1 - 3      13.      16.       3.                       37.
       CALANOIDA
           DIAPTOMUS ARAPAHOENSIS (37060)                  1 - 3     173.     169.     119.                      461.
   ROTIFERA
       BRACHIONIDAE
           KERATELLA COCHLEARIS (54270)                    1 - 3       0.      48.      32.                       80.
           KERATELLA QUADRATA (54300)                      1 - 3      64.     165.     138.                      367.
       ASPLANCHNIDAE
           ASPLANCHNA PRIODONTA (55660)                    1 - 3       0.       4.       0.                        4.
       SYNCHAETIDAE
           POLYARTHRA SPP. (55760)                         1 - 3      16.      20.      19.                       55.
       TESTUDINELLIDAE
           FILINIA TERMINALIS (56065)                      1 - 3       3.       8.      19.                       30.
       CONOCHILIDAE
           CONOCHILUS UNICORNIS (56463)                    1 - 3     241.     173.     141.                      555.


               TOTAL FOR  11 SPECIES BY REPLICATE:         1 - 3     635.     731.     573.

               TOTAL FOR   3 REPLICATES,  11 SPECIES:            1939.
```

APPENDIX D. RAW QUANTITATIVE INVERTEBRATE SAMPLE DATA FROM COLORADO FLAT TOPS STUDY LAKES, 1982.

```
PROJECT:  ACID RAIN PROJECT (AP)                    AREA:  NED WILSON LAKE (33)                        DATE:  AUGUST 17, 1982
STATION:  EQUIDISTANT 3 SHORES-SE COVE; DEPTH 4.1M                                                       SUBSTATION:    1
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (60)
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  NED KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                   RAW DATA TABLES

 1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                  REPLICATES           COUNTS                       TOTAL FOR SP.
           GENUS/SPECIES

 DIPTERA
      CHIRONOMIDAE, S-FAMILY TANYPODINAE
           PROCLADIUS SP. (10950)                           1 - 2      3.       3.
      CHIRONOMIDAE, TRIBE CHIRONOMINI                                                                             6.
           CHIRONOMUS SP. 1 (12255)                         1 - 2     10.       5.
           CRYPTOCHIRONOMUS SP. (12390)                     1 - 2      1.       0.                               15.
           PAGASTIELLA SP. (13350)                          1 - 2      4.       0.                                1.
           CLADOPELMA SP. (13400)                           1 - 2      0.       2.                                4.
      CHIRONOMIDAE, TRIBE TANYTARSINI                                                                             2.
           CORYNOCERA SP. (13900)                           1 - 2      8.      13.
           LENZIELLA SP. (13990)                            1 - 2     19.      15.                               21.
 OSTRACODA                                                                                                       34.
      CYPRIDAE
           CANDONA SCOPULOSA (33600)                        1 - 2     22.      25.
 OLIGOCHAETA                                                                                                     47.
      NAIDIDAE
           UNCINAIS UNCINATA (59025)                        1 - 2      4.       0.
      LUMBRICULIDAE                                                                                               4.
           LUMBRICULIDAE - ALL (59040)                      1 - 2      5.       3.
      TUBIFICIDAE                                                                                                 8.
           IMMATURE TUBIFICIDAE - W.C.C.C. (60000)          1 - 2      5.       4.
           IMMATURE TUBIFICIDAE - W.C.C. (60010)            1 - 2      1.       0.                                9.
           LIMNODRILUS HOFFMEISTERI (SPIRALIS FORM) (60020) 1 - 2      2.       0.                                1.
 PELECYPODA                                                                                                       2.
      SPHAERIIDAE
           PISIDIUM SP. (65025)                             1 - 2     44.      43.
                                                                                                                 87.


                TOTAL FOR  14 SPECIES BY REPLICATE:         1 - 2    128.     113.


                TOTAL FOR   2 REPLICATES,  14 SPECIES:               241.
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                                                                                                  PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)
STATION:  MIDLAKE, TURK'S BOUY; DEPTH 5.3M           AREA:  NED WILSON LAKE (23)                 DATE:  AUGUST 17, 1982
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (60)                                                     SUBSTATION:    2
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                      RAW DATA TABLES

   1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
         GENUS/SPECIES                                        REPLICATES          COUNTS                        TOTAL FOR SP.

DIPTERA
    CHIRONOMIDAE, S-FAMILY TANYPODINAE
         PROCLADIUS SP. (10950)
    CHIRONOMIDAE, TRIBE CHIRONOMINI                            1 - 3      6.       6.       12.                      24.
         CHIRONOMUS SP. 1 (12255)
         CRYPTOCHIRONOMUS SP. (12390)                          1 - 3     14.      19.       15.                      48.
         PSEUDOCHIRONOMUS SP. (13250)                          1 - 3      1.       0.        0.                       1.
         PAGASTIELLA SP. (13350)                               1 - 3      0.       1.        0.                       1.
         CLADOPELMA SP. (13400)                                1 - 3      0.       2.        0.                       2.
    CHIRONOMIDAE, TRIBE TANYTARSINI                            1 - 3      5.       1.        0.                       6.
         TANYTARSUS SP. (13700)
         CORYNOCERA SP. (13900)                                1 - 3      0.       1.        0.                       1.
         LENZIELLA SP. (13990)                                 1 - 3     16.      13.       11.                      40.
    CHIRONOMIDAE, S-FAM ORTHOCLADIINAE                         1 - 3     67.      55.       24.                     146.
         SYNORTHOCLADIUS SP. (16010)
OSTRACODA                                                      1 - 3      1.       0.        0.                       1.
    CYPRIDAE
         CANDONA SCOPULOSA (33600)
OLIGOCHAETA                                                    1 - 3     40.       0.       35.                      75.
    NAIDIDAE
         UNCINAIS UNCINATA (59025)
    LUMBRICULIDAE                                              1 - 3      6.      13.        0.                      19.
         LUMBRICULIDAE - ALL (59040)
    TUBIFICIDAE                                                1 - 3      8.       2.        3.                      13.
         IMMATURE TUBIFICIDAE - W.C.C.C. (60000)
         LIMNODRILUS HOFFMEISTERI (SPIRALIS FORM) (60020)      1 - 3     28.      17.       14.                      59.
HIRUDINEA                                                      1 - 3      4.       2.        4.                      10.
    GLOSSIPHONIIDAE
         HELOBDELLA STAGNALIS (62610)
PELECYPODA                                                     1 - 3      2.       0.        0.                       2.
    SPHAERIIDAE
         PISIDIUM SP. (65025)
                                                               1 - 3     54.      56.       38.                     148.
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                                                                                                         PAGE  2
PROJECT:  ACID RAIN PROJECT (AR)                   AREA:  NED WILSON LAKE (23)                     DATE:  AUGUST 17, 1982
STATION:  MIDLAKE, TURK'S BUOY; DEPTH 5.3M                                                          SUBSTATION:    2
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (60)
NUMBER OF REPLICATES:    3     FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                        RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                     REPLICATES            COUNTS                       TOTAL FOR SP.
         GENUS/SPECIES

                TOTAL FOR  17 SPECIES BY REPLICATE:        1 - 3     252.     188.     156.

                TOTAL FOR   3 REPLICATES,  17 SPECIES:               596.
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                                                                                                  PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)              AREA:  NED WILSON LAKE (23)                DATE:  AUGUST 17, 1982
STATION:  EQUIDISTANT 3 SHORES-N COVE; DEPTH 2.5M                                        SUBSTATION:    3
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (66)
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                     RAW DATA TABLES

  1ST LEVEL REFERENCE
     2ND LEVEL REFERENCE                                     REPLICATES        COUNTS                          TOTAL FOR SP.
        GENUS/SPECIES

  DIPTERA
     CHIRONOMIDAE, S-FAMILY TANYPODINAE
        PROCLADIUS SP. (10950)                               1 - 3      1.       2.       0.                         3.
     CHIRONOMIDAE, TRIBE CHIRONOMINI
        CRYPTOCHIRONOMUS SP. (12390)                         1 - 3      0.       1.       0.                         1.
        PAGASTIELLA SP. (13350)                              1 - 3      4.       0.       1.                         5.
     CHIRONOMIDAE, TRIBE TANYTARSINI
        CORYNOCERA SP. (13900)                               1 - 3     31.      20.      22.                        73.
        LENZIELLA SP. (13990)                                1 - 3      6.       1.       0.                         7.
  OSTRACODA
     CYPRIDAE
        CANDONA SCOPULOSA (33600)                            1 - 3      0.       0.      20.                        20.
  OLIGOCHAETA
     NAIDIDAE
        UNCINAIS UNCINATA (59028)                            1 - 3      4.       2.       6.                        12.
     LUMBRICULIDAE
        LUMBRICULIDAE - ALL (59040)                          1 - 3      7.       0.       4.                        11.
     TUBIFICIDAE
        IMMATURE TUBIFICIDAE - W.C.C.C. (60000)              1 - 3      3.       0.       1.                         4.
        LIMNODRILUS HOFFMEISTERI (SPIRALIS FORM) (60020)     1 - 3      0.       0.       3.                         3.
     ENCHYTRAEIDAE
        ENCHYTRAEIDAE - ALL (61000)                          1 - 3      0.       1.       0.                         1.
  PELECYPODA
     SPHAERIIDAE
        PISIDIUM SP. (65028)                                 1 - 3     54.      53.      56.                       163.


              TOTAL FOR  12 SPECIES BY REPLICATE:            1 - 3    110.      80.     113.

              TOTAL FOR   3 REPLICATES,  12 SPECIES:                  303.
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                                                                                              PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                    AREA:  NED WILSON LAKE (23)                       DATE:  AUGUST 17, 1982
STATION:  100M OFFSHORE-N SHALLOW COVE; DEPTH 5.0M                                                     SUBSTATION:     4
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (60)
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                       RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                   REPLICATES          COUNTS                          TOTAL FOR SP.
           GENUS/SPECIES

  DIPTERA
      CHIRONOMIDAE
           CHIRONOMIDAE (ALL) (10510)                        1 -  3      0.        0.        4.                          4.
      CHIRONOMIDAE, S-FAMILY TANYPODINAE
           PROCLADIUS SP. (10950)                            1 -  3     12.        8.        5.                         25.
      CHIRONOMIDAE, TRIBE CHIRONOMINI
           CHIRONOMUS SP. 1 (12255)                          1 -  3     20.       13.       22.                         55.
           DICROTENDIPES SP. (12410)                         1 -  3      0.        0.        1.                          1.
           PAGASTIELLA SP. (13350)                           1 -  3      0.        0.        2.                          2.
           CLADOPELMA SP. (13400)                            1 -  3      1.        2.        2.                          5.
      CHIRONOMIDAE, TRIBE TANYTARSINI
           CORYNOCERA SP. (13900)                            1 -  3     10.        8.        9.                         27.
           LENZIELLA SP. (13990)                             1 -  3     17.       13.       18.                         48.
      CERATOPOGONIDAE
           PALPOMYIA SP. (18030)                             1 -  3      1.        0.        0.                          1.
  OSTRACODA
      CYPRIDAE
           CANDONA SCOPULOSA (33600)                         1 -  3     15.        0.       25.                         40.
  OLIGOCHAETA
      NAIDIDAE
           UNCINAIS UNCINATA (59025)                         1 -  3      0.        0.        1.                          1.
      LUMBRICULIDAE
           LUMBRICULIDAE - ALL (59040)                       1 -  3      2.        0.        3.                          5.
      TUBIFICIDAE
           IMMATURE TUBIFICIDAE - W.C.C.C. (60000)           1 -  3      8.        5.        8.                         21.
           LIMNODRILUS HOFFMEISTERI (SPIRALIS FORM) (60020)  1 -  3      2.        3.        0.                          5.
  PELECYPODA
      SPHAERIIDAE
           PISIDIUM SP. (65025)                              1 -  3     49.       35.       60.                        144.


                 TOTAL FOR  15 SPECIES BY REPLICATE:         1 -  3    137.       87.      160.

                 TOTAL FOR   3 REPLICATES,  15 SPECIES:                384.
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                                                                                                   PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)
STATION:  EQUIDISTANT 3 SHORES-NW END; DEPTH 3.0M         AREA:  OYSTER LAKE (24)
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (6C)                                                 DATE:  AUGUST 18, 1982
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  WEB KINNEY (5)                                SUBSTATION:    1
NOTE:  NOT APPLICABLE (0)

                                                            RAW DATA TABLES

   1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE
           GENUS/SPECIES                                   REPLICATES          COUNTS                         TOTAL FOR SP.

   EPHEMEROPTERA
       CAENIDAE
           CAENIS SP. (2710)
   DIPTERA                                                  1 - 3      9.      19.      20.                           48.
       CHIRONOMIDAE, S-FAMILY TANYPODINAE
           PROCLADIUS SP. (10950)
       CHIRONOMIDAE, TRIBE CHIRONOMINI                      1 - 3     18.      37.      19.
           DICROTENDIPES SP. (12410)                                                                                  74.
           MICROTENDIPES SP. 1 (12525)                      1 - 3      3.      22.      24.
           POLYPEDILUM SP. (12601)                          1 - 3      4.      10.       6.                           49.
           PSEUDOCHIRONOMUS SP. (13250)                     1 - 3      1.       1.       1.                           20.
           PAGASTIELLA SP. (13350)                          1 - 3     63.      49.      70.                            3.
           CLADOPELMA SP. (13400)                           1 - 3     31.      93.      84.                          182.
       CHIRONOMIDAE, TRIBE TANYTARSINI                      1 - 3      1.       0.       0.                          208.
           TANYTARSUS SP. (13700)                                                                                      1.
           LENZIELLA SP. (13990)                            1 - 3      8.      11.       9.
       CERATOPOGONIDAE                                      1 - 3      0.       2.       0.                           28.
           PALPOMYIA SP. (18030)                                                                                       2.
   COLEOPTERA                                               1 - 3     12.       2.      10.
       DYTISCIDAE                                                                                                     24.
           HYDROPORUS SP. 1 (20460)
   CLADOCERA                                                1 - 3      1.       0.       0.
       SIDIDAE                                                                                                         1.
           LATONA SETIFERA (31605)
   OSTRACODA                                                1 - 3      1.       0.       0.
       CYPRIDIDAE                                                                                                      1.
           CANDONA SCOPULOSA (33600)
   AMPHIPODA                                                1 - 3      1.       0.       0.                            1.
       TALITRIDAE
           HYALELLA AZTECA (41060)
   NEMATODA                                                 1 - 3     16.      15.      12.
                                                                                                                      43.
           NEMATODA - ALL (50610)
   OLIGOCHAETA                                              1 - 3      7.       0.      10.
       NAIDIDAE                                                                                                       17.
           UNCINAIS UNCINATA (59025)
                                                            1 - 3      2.       4.      18.                           24.
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PROJECT:  ACID RAIN PROJECT (AP)                      AREA:  OYSTER LAKE (24)                 DATE:  AUGUST 10, 1982
STATION:  EQUIDISTANT 3 SHORES-NW END; DEPTH 3.0M                                             SUBSTATION:    1
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (60)
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                     RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                        REPLICATES          COUNTS                          TOTAL FOR SP.
          GENUS/SPECIES

  OLIGOCHAETA
      TUBIFICIDAE
          IMMATURE TUBIFICIDAE - W.O.C.C. (60000)                 1 - 3       0.        2.        0.                         2.
          IMMATURE TUBIFICIDAE - W.C.C. (60010)                   1 - 3       2.        0.        3.                         5.
          ILYODRILUS TEMPLETONI (60030)                           1 - 3       1.        1.        2.                         4.
      ENCHYTRAEIDAE
          ENCHYTRAEIDAE - ALL (61000)                             1 - 3      20.        0.       15.                        35.
  HIRUDINEA
      ERPOBDELLIDAE
          NEPHELOPSIS OBSCURA (62532)                             1 - 3       2.        2.        1.                         5.
      GLOSSIPHONIIDAE
          GLOSSIPHONIA COMPLANATA (62590)                         1 - 3       2.        0.        2.                         4.
  PELECYPODA
      SPHAERIIDAE
          PISIDIUM SP. (65025)                                    1 - 3      47.       22.       37.                       106.


                   TOTAL FOR  24 SPECIES BY REPLICATE:            1 - 3     252.      292.      343.


                   TOTAL FOR   3 REPLICATES,  24 SPECIES:                   887.
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PROJECT:  ACID RAIN PROJECT (AR)                              AREA:  OYSTER LAKE (24)
STATION:  EQUIDISTANT 3 SHORES-FAR COVE; DEPTH 2.5M                                                    DATE:  AUGUST 18, 1982
SAMPLER TYPE:  EKMAN DREDGE BOTTOM GRAB (60)                                                            SUBSTATION:    2
NUMBER OF REPLICATES:   3      FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                               RAW DATA TABLES

1ST LEVEL REFERENCE
    2ND LEVEL REFERENCE
        GENUS/SPECIES                                  REPLICATES         COUNTS                           TOTAL FOR SP.

EPHEMEROPTERA
    BAETIDAE
        CALLIBAETIS COLORADENSIS (1712)                  1 - 3      0.      0.      1.                        1.
    CAENIDAE
        CAENIS SP. (2710)                                1 - 3      2.      3.     14.                       19.
DIPTERA
    CHIRONOMIDAE, S-FAMILY TANYPODINAE
        PROCLADIUS SP. (10950)                           1 - 3      7.     22.     35.                       64.
    CHIRONOMIDAE, TRIBE CHIRONOMINI
        DICROTENDIPES SP. (12410)                        1 - 3     23.     25.     24.                       72.
        MICROTENDIPES SP. 1 (12925)                      1 - 3      5.      2.      2.                        9.
        POLYPEDILUM SP. (12601)                          1 - 3      0.      1.      0.                        1.
        PSEUDOCHIRONOMUS SP. (13250)                     1 - 3    156.    152.    191.                      499.
        PAGASTIELLA SP. (13350)                          1 - 3     54.     53.     47.                      154.
        CLADOPELMA SP. (13400)                           1 - 3      0.      0.      2.                        2.
    CHIRONOMIDAE, TRIBE TANYTARSINI
        TANYTARSUS SP. (13700)                           1 - 3     14.     15.      4.                       33.
        LENZIELLA SP. (13990)                            1 - 3      0.      3.      1.                        4.
    CERATOPOGONIDAE
        PALPOMYIA SP. (18030)                            1 - 3      6.      3.      9.                       18.
AMPHIPODA
    TALITRIDAE
        HYALELLA AZTECA (41060)                          1 - 3      1.      4.      4.                        9.
NEMATODA

        NEMATODA - ALL (50610)                           1 - 3      5.      3.      2.                       10.
OLIGOCHAETA
    NAIDIDAE
        UNCINAIS UNCINATA (59025)                        1 - 3      0.      4.      1.                        5.
    LUMBRICULIDAE
        LUMBRICULIDAE - ALL (59040)                      1 - 3      0.      0.     11.                       11.
    TUBIFICIDAE
        IMMATURE TUBIFICIDAE - W.C.C.C. (60000)          1 - 3      1.      0.      2.                        3.
        IMMATURE TUBIFICIDAE - W.C.C. (60010)            1 - 3      1.      4.      0.                        5.
        ILYODRILUS TEMPLETONI (60030)                    1 - 3      1.      0.      3.                        4.
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                                                                                                    PAGE  2

PROJECT:  ACID RAIN PROJECT (AR)                           AREA:  OYSTER LAKE (24)                       DATE:  AUGUST 18, 1982
STATION:  EQUIDISTANT 3 SHORES-ESE COVE; DEPTH 2.5M                                                       SUBSTATION:    2
SAMPLER TYPE:  EKMAN DREDGE BOTTOM GRAB (6C)
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                    RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                      REPLICATES          COUNTS                              TOTAL FOR SP.
          GENUS/SPECIES

  OLIGOCHAETA
      ENCHYTRAEIDAE
          ENCHYTRAEIDAE - ALL (61000)                           1 -  3      11.       3.       0.                                14.
  HIRUDINEA
      ERPOBDELLIDAE
          NEPHELOPSIS OBSCURA (62532)                           1 -  3       0.       1.       2.                                 3.
      GLOSSIPHONIIDAE
          GLOSSIPHONIA COMPLANATA (62590)                       1 -  3       0.       1.       0.                                 1.
  PELECYPODA
      SPHAERIIDAE
          PISIDIUM SP. (65025)                                  1 -  3      14.      28.      34.                                76.


                TOTAL FOR  23 SPECIES BY REPLICATE:             1 -  3     301.     327.     389.

                TOTAL FOR   3 REPLICATES,  23 SPECIES:                    1017.
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                                                                                                        PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                          AREA:  UPPER ISLAND LAKE (25)
STATION:  MIDBASIN-NE BASIN, TURK'S BOUY; DEPTH 15.0M                                             DATE:  AUGUST 20, 1982
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (60)                                                      SUBSTATION:    4
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                  RAW DATA TABLES

   1ST LEVEL REFERENCE
        2ND LEVEL REFERENCE
             GENUS/SPECIES                                 REPLICATES           COUNTS                              TOTAL FOR SP.

   DIPTERA
        CHIRONOMIDAE, S-FAMILY TANYPODINAE
             PROCLADIUS SP. (10950)
        CHIRONOMIDAE, TRIBE CHIRONOMINI                    1 - 3      10.      24.      13.                               47.
             CHIRONOMUS SP. 1 (12255)                      1 - 3       6.       9.       2.                               17.
             CHIRONOMUS SP. 2 (12256)                      1 - 3      80.     105.      83.                              268.
             PAGASTIELLA SP. (13350)                       1 - 3       1.       0.       0.                                1.
             PHAENOPSECTRA SP. (13360)                     1 - 3       0.       1.       0.                                1.
        CHIRONOMIDAE, TRIBE TANYTARSINI
             CORYNOCERA SP. (13900)
   CLADOCERA                                               1 - 3       0.       2.       2.                                4.
        DAPHNIIDAE
             CERIODAPHNIA QUADRANGULA (32075)
   OSTRACODA                                               1 - 3       0.       1.       0.                                1.
        CYPRIDAE
             CANDONA SCOPULOSA (33600)
   COPEPODA                                                1 - 3      56.      53.       0.                              109.
        CALANOIDA
             DIAPTOMUS ARAPAHOENSIS (37060)
   OLIGOCHAETA                                             1 - 3      16.      13.       0.                               29.
        NAIDIDAE
             UNCINAIS UNCINATA (59035)
        TUBIFICIDAE                                        1 - 3       0.       1.       0.                                1.
             IMMATURE TUBIFICIDAE - W.C.C.C. (60000)
             IMMATURE TUBIFICIDAE - W.C.C. (60010)         1 - 3      92.      66.       9.                              167.
             LIMNODRILUS HOFFMEISTERI (SPIRALIS FORM) (60020)  1 - 3  19.      12.       5.                               36.
             ILYODRILUS TEMPLETONI (60030)                 1 - 3      11.      14.       5.                               30.
                                                           1 - 3       3.       2.       3.                                8.

                 TOTAL FOR  14 SPECIES BY REPLICATE:       1 - 3     294.     303.     122.

                 TOTAL FOR   3 REPLICATES,  14 SPECIES:              719.
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APPENDIX E. RAW QUANTITATIVE INVERTEBRATE SAMPLE DATA FROM COLORADO FLAT TOPS STUDY LAKES, 1983.

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                                                                                                                     PAGE  1

PROJECT:  ACID RAIN PROJECT (AP)                    AREA:  NEC WILSON LAKE (23)                    DATE:  AUGUST 25, 1983
STATION:  EQUIDISTANT 3 SHORES-SE COVE; DEPTH 4.3M                                                  SUBSTATION:    1
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (60)
NUMBER OF REPLICATES:   3      FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NOT APPLICABLE (0)

                                                   RAW DATA TABLES

   1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE                                        REPLICATES          COUNTS                            TOTAL FOR SP.
           GENUS/SPECIES

   DIPTERA
       CHIRONOMIDAE, S-FAMILY TANYPODINAE
           PROCLADIUS SP. (10950)                                   1 - 3       3.       5.       5.                          13.
       CHIRONOMIDAE, TRIBE CHIRONOMINI
           CHIRONOMUS SP. 1 (12255)                                 1 - 3       7.       5.       6.                          18.
           CRYPTOCHIRONOMUS SP. (12390)                             1 - 3       1.       0.       0.                           1.
           MICROTENDIPES SP. 1 (12525)                              1 - 3       0.       2.       0.                           2.
           PAGASTIELLA SP. (13350)                                  1 - 3       2.       8.       1.                          11.
           CLADOPELMA SP. (13400)                                   1 - 3       1.       1.       1.                           3.
       CHIRONOMIDAE, TRIBE TANYTARSINI
           CORYNOCERA SP. (13900)                                   1 - 3       4.       6.       4.                          14.
           LENZIELLA SP. (13990)                                    1 - 3       3.       8.       1.                          12.
   OSTRACODA
       CYPRIDAE
           CANDONA SCOPULOSA (33600)                                1 - 3       0.      30.       0.                          30.
   NEMATODA

           NEMATODA - ALL (50610)                                   1 - 3       3.       0.       1.                           4.
   OLIGOCHAETA
           OLIGOCHAETA - ALL (59010)                                1 - 3       5.       0.       0.                           5.
       NAIDIDAE
           UNCINAIS UNCINATA (59025)                                1 - 3       4.       2.       0.                           6.
       LUMBRICULIDAE
           LUMBRICULIDAE - ALL (59040)                              1 - 3       2.       1.       1.                           4.
       TUBIFICIDAE
           IMMATURE TUBIFICIDAE - W.C.C.C. (60000)                  1 - 3      13.      26.      17.                          56.
           IMMATURE TUBIFICIDAE - W.C.C. (60010)                    1 - 3       1.       0.       1.                           2.
           LIMNODRILUS HOFFMEISTERI (SPIRALIS FORM) (60020)         1 - 3       0.       6.       0.                           6.
   HIRUDINEA
       GLOSSIPHONIIDAE
           HELOBDELLA STAGNALIS (62610)                             1 - 3       0.       0.       1.                           1.
   PELECYPODA
       SPHAERIIDAE
           PISIDIUM SP. (65025)                                     1 - 3      26.      32.      32.                          90.
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                                                                                                      PAGE  2
PROJECT:  ACID RAIN PROJECT (AR)                    AREA:  NED WILSON LAKE (23)
STATION:  EQUIDISTANT 3 SHORES-SE COVE; DEPTH 4.3M                                                 DATE:  AUGUST 25, 1983
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (60)                                                      SUBSTATION:    1
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  BARRY MALDIGO (21)
NOTE:  NOT APPLICABLE (0)

                                             RAW DATA TABLES

   1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
         GENUS/SPECIES                                   REPLICATES          COUNTS                          TOTAL FOR SP.

               TOTAL FOR  10 SPECIES BY REPLICATE:        1 - 3       75.      132.      71.

               TOTAL FOR   3 REPLICATES,  10 SPECIES:                  278.
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                                                                                                    PAGE  1

PROJECT:  ACID RAIN PROJECT (AP)                 AREA:  NED WILSON LAKE (23)                   DATE:  AUGUST 25, 1983
STATION:  MIDLAKE, TURK'S ROOT; DEPTH 5.3M                                                      SUBSTATION:    2
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (60)
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NOT APPLICABLE (0)

                                                      RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
            GENUS/SPECIES                                    REPLICATES            COUNTS                         TOTAL FOR SP.

  DIPTERA
      CHIRONOMIDAE, S-FAMILY TANYPODINAE
            ABLABESMYIA SP. (10621)                           1 - 3        1.        1.        0.                       2.
            PROCLADIUS SP. (10950)                            1 - 3        5.        8.        5.                      18.
      CHIRONOMIDAE, TRIBE CHIRONOMINI
            CHIRONOMUS SP. 1 (12255)                          1 - 3       19.       14.       15.                      48.
            MICROTENDIPES SP. 1 (12925)                       1 - 3        2.        5.        0.                       7.
            PAGASTIELLA SP. (13350)                           1 - 3        0.        1.        0.                       1.
            CLADOPELMA SP. (13400)                            1 - 3        1.        1.        2.                       4.
      CHIRONOMIDAE, TRIBE TANYTARSINI
            CORYNOCERA SP. (13900)                            1 - 3        2.        2.        4.                       8.
            LENZIELLA SP. (13990)                             1 - 3        9.       12.        7.                      28.
      CHIRONOMIDAE, S-FAM ORTHOCLADIINAE
            HETEROTRISSOCLADIUS SP. (14810)                   1 - 3        1.        0.        0.                       1.
      CHIRONOMIDAE, TRIBE DIAMESINAE
            PSEUDOKIEFFERIELLA SP. (16905)                    1 - 3        0.        1.        0.                       1.
  OSTRACODA
      CYPRIDAE
            CANDONA SCOPULOSA (33600)                         1 - 3       20.       17.       11.                      48.
  COPEPODA
      CYCLOPOIDA
            CYCLOPS VERNALIS (38250)                          1 - 3        1.        0.        0.                       1.
  NEMATODA

            NEMATODA - ALL (50610)                            1 - 3        0.        0.        4.                       4.
  OLIGOCHAETA
      NAIDIDAE
            UNCINAIS UNCINATA (59025)                         1 - 3        0.        0.        1.                       1.
      LUMBRICULIDAE
            LUMBRICULIDAE - ALL (59040)                       1 - 3        2.        2.        2.                       6.
      TUBIFICIDAE
            IMMATURE TUBIFICIDAE - N.C.C.C. (60000)           1 - 3        2.        1.        0.                       3.
  HIRUDINEA
      GLOSSIPHONIIDAE
            HELOBDELLA STAGNALIS (62610)                      1 - 3        2.        1.        2.                       5.
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                                                                                                    PAGE  2

PROJECT:  ACID RAIN PROJECT (AR)                 AREA:  RED WILSON LAKE (23)                    DATE:  AUGUST 28, 1983
STATION:  MIDLAKE, TURK'S ROUTE; DEPTH 9.3M                                                      SUBSTATION:    3
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (60)
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  BARRY MALDIGO (21)
NOTE:  NOT APPLICABLE (0)

                                                     RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                   REPLICATES          COUNTS                      TOTAL FOR SP.
          GENUS/SPECIES

  PELECYPODA
      SPHAERIIDAE
          PISIDIUM SP. (69025)                               1 - 3     32.      31.      32.                          95.


              TOTAL FOR  10 SPECIES BY REPLICATE:            1 - 3     99.      97.      85.

              TOTAL FOR  3 REPLICATES,  10 SPECIES:                   281.
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PROJECT:  ACID RAIN PROJECT (AR)                          AREA:  NED WILSON LAKE (23)                       DATE:  AUGUST 25, 1983
STATION:  EQUIDISTANT 3 SHORES-N COVE; DEPTH 2.5M                                                           SUBSTATION:    3
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (60)
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  BARRY MALDIGO (21)
NOTE:  NOT APPLICABLE (0)

                                                     RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
           GENUS/SPECIES                                   REPLICATES            COUNTS                             TOTAL FOR SP.

  DIPTERA
      CHIRONOMIDAE, S-FAMILY TANYPODINAE
           PROCLADIUS SP. (10950)                            1 - 3       3.        3.        4.                           10.
      CHIRONOMIDAE, TRIBE CHIRONOMINI
           CHIRONOMUS SP. 1 (12255)                          1 - 3       0.        1.        0.                            1.
           MICROTENDIPES SP. 1 (12525)                       1 - 3       4.       15.       24.                           43.
           PAGASTIELLA SP. (13350)                           1 - 3       1.        0.        5.                            6.
           CLADOPELMA SP. (13400)                            1 - 3       0.        0.        1.                            1.
      CHIRONOMIDAE, TRIBE TANYTARSINI
           CORYNOCERA SP. (13900)                            1 - 3       3.        4.        5.                           12.
           LENZIELLA SP. (13990)                             1 - 3       1.        1.       13.                           15.
  OSTRACODA
      CYPRIDAE
           CANDONA SCOPULOSA (33600)                         1 - 3       2.        1.        0.                            3.
  COPEPODA
      CYCLOPOIDA
           MACROCYCLOPS ALBIDUS (38110)                      1 - 3       1.        0.        0.                            1.
  OLIGOCHAETA

           OLIGOCHAETA - ALL (59010)                         1 - 3       1.        0.        0.                            1.
      LUMBRICULIDAE
           LUMBRICULIDAE - ALL (59040)                       1 - 3       3.        5.        2.                           10.
      TUBIFICIDAE
           IMMATURE TUBIFICIDAE - W.C.C.C. (60000)           1 - 3       3.        1.        1.                            5.
  PELECYPODA
      SPHAERIIDAE
           PISIDIUM SP. (65025)                              1 - 3      50.       46.       44.                          140.


                  TOTAL FOR  13 SPECIES BY REPLICATE:        1 - 3      72.       77.       99.

                  TOTAL FOR   3 REPLICATES,  13 SPECIES:               248.
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                                                                                                      PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                          AREA:  NED WILSON LAKE (23)
STATION:  100M OFFSHORE-W SHALLOW COVE; DEPTH 5.0M                                              DATE:  AUGUST 25, 1983
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (60)                                                    SUBSTATION:    4
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NOT APPLICABLE (0)

                                                    RAW DATA TABLES

  1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE
            GENUS/SPECIES                                  REPLICATES          COUNTS                           TOTAL FOR SP.

  DIPTERA
       CHIRONOMIDAE, S-FAMILY TANYPODINAE
            ABLABESMYIA SP. (10621)                          1 - 3       1.       1.       0.                          2.
            PROCLADIUS SP. (10950)                           1 - 3       7.      10.       5.                         22.
       CHIRONOMIDAE, TRIBE CHIRONOMINI
            CHIRONOMUS SP. 1 (12255)                         1 - 3      14.      20.      25.                         59.
            CRYPTOCHIRONOMUS SP. (12390)                     1 - 3       0.       0.       2.                          2.
            MICROTENDIPES SP. 1 (12525)                      1 - 3       2.       1.      10.                         13.
            CLADOPELMA SP. (13400)                           1 - 3       0.       2.       3.                          5.
       CHIRONOMIDAE, TRIBE TANYTARSINI
            CORYNOCERA SP. (13900)                           1 - 3       2.       4.       2.                          8.
            LENZIELLA SP. (13990)                            1 - 3      14.      45.      34.                         93.
       CHIRONOMIDAE, S-FAM ORTHOCLADIINAE
            CORYNONEURA SP (14415)                           1 - 3       0.       0.       1.                          1.
       CHIRONOMIDAE, TRIBE DIAMESINAE
            PSEUDOKIEFFERIELLA SP. (16505)                   1 - 3       0.       1.       0.                          1.
  COLEOPTERA
       DYTISCIDAE
            DERONECTES GRISEOSTRIATUS (20483)                1 - 3       0.       0.       1.                          1.
  CLADOCERA
       HOLOPEDIDAE
            HOLOPEDIUM GIBBERUM (31722)                      1 - 3       1.       1.       4.                          6.
  OSTRACODA
       CYPRIDAE
            CANDONA SCOPULOSA (33600)                        1 - 3       6.      13.      25.                         44.
  NEMATODA

            NEMATODA - ALL (50610)                           1 - 3       0.       0.       1.                          1.
  OLIGOCHAETA
       NAIDIDAE
            NAIDIDAE - ALL (59020)                           1 - 3       1.       0.       0.                          1.
            NAIS SPP. (59021)                                1 - 3       1.       0.       0.                          1.
            UNCINAIS UNCINATA (59025)                        1 - 3       0.       0.       2.                          2.
       LUMBRICULIDAE
            LUMBRICULIDAE - ALL (59040)                      1 - 3       3.       2.       2.                          7.
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                                                                                                    PAGE  2

PROJECT:  ACID RAIN PROJECT (AR)                    AREA:  NED WILSON LAKE (33)                    DATE:  AUGUST 25, 1983
STATION:  100M OFFSHORE-W SHALLOW COVE; DEPTH 5.0M                                                  SUBSTATION:    4
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (60)
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  HARRY PALDIGO (21)
NOTE:  NOT APPLICABLE (0)

                                                        RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                          REPLICATES           COUNTS                        TOTAL FOR SP.
          GENUS/SPECIES

  OLIGOCHAETA
      TUBIFICIDAE
          IMMATURE TUBIFICIDAE - W.C.C.C. (60000)                  1 - 3        8.      10.       1.                        19.
          LIMNODRILUS HOFFMEISTERI (SPIRALIS FORM) (60020)         1 - 3        1.       1.       0.                         2.
  HIRUDINEA
      GLOSSIPHONIIDAE
          HELOBDELLA STAGNALIS (62610)                             1 - 3        1.       0.       0.                         1.
  PELECYPODA
      SPHAERIIDAE
          PISIDIUM SP. (68025)                                     1 - 3       48.      43.      36.                       127.


              TOTAL FOR  22 SPECIES BY REPLICATE:                  1 - 3      107.     154.     154.

              TOTAL FOR   3 REPLICATES,  22 SPECIES:                          415.
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                                                                                                          PAGE  1

PROJECT:  ACID RAIN PROJECT (AR)                    AREA:  OYSTER LAKE (24)                              DATE:  AUGUST 24, 1983
STATION:  EQUIDISTANT 3 SHORES-NW END; DEPTH 3.0M                                                        SUBSTATION:    1
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (6C)
NUMBER OF REPLICATES:   3      FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NOT APPLICABLE (0)

                                                    RAW DATA TABLES

   1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                         REPLICATES         COUNTS                          TOTAL FOR SP.
         GENUS/SPECIES

   EPHEMEROPTERA
      BAETIDAE
         CALLIBAETIS COLORADENSIS (1712)                          1 - 3        0.        1.        1.                           2.
      CAENIDAE
         CAENIS SP. (2710)                                        1 - 3        8.       13.       12.                          33.
   DIPTERA
      CHIRONOMIDAE, S-FAMILY TANYPODINAE
         PROCLADIUS SP. (10950)                                   1 - 3       13.       24.       35.                          72.
      CHIRONOMIDAE, TRIBE CHIRONOMINI
         DICROTENDIPES SP. (12410)                                1 - 3       67.       26.      104.                         197.
         MICROTENDIPES SP. 1 (12925)                              1 - 3        6.       14.       32.                          52.
         POLYPEDILUM SP. (12601)                                  1 - 3        0.        0.        1.                           1.
         PSEUDOCHIRONOMUS SP. (13250)                             1 - 3       31.       22.       24.                          77.
         PAGASTIELLA SP. (13350)                                  1 - 3       33.       35.       36.                         104.
      CHIRONOMIDAE, TRIBE TANYTARSINI
         TANYTARSUS SP. (13700)                                   1 - 3       55.      273.      187.                         515.
         LENZIELLA SP. (13990)                                    1 - 3        3.        4.        2.                           9.
      CERATOPOGONIDAE
         PALPOMYIA SP. (18030)                                    1 - 3        6.       10.       10.                          26.
   COLEOPTERA
      DYTISCIDAE
         DERONECTES GRISEOSTRIATUS (20483)                        1 - 3        1.        0.        0.                           1.
   CLADOCERA
      SIDIDAE
         LATONA SETIFERA (31605)                                  1 - 3        0.        0.        4.                           4.
      DAPHNIDAE
         DAPHNIA PULEX (31790)                                    1 - 3        1.        0.        0.                           1.
   OSTRACODA
      CYPRIDAE
         CANDONA SCOPULOSA (33600)                                1 - 3        0.        1.        0.                           1.
   COPEPODA
      CALANOIDA
         DIAPTOMUS COLORADENSIS (37059)                           1 - 3        0.        0.        4.                           4.
         DIAPTOMUS SHOSHONE (37061)                               1 - 3        0.        0.        1.                           1.
   AMPHIPODA
      TALITRIDAE
         HYALELLA AZTECA (41060)                                  1 - 3        2.        3.        3.                           8.
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PROJECT:  ACID RAIN PROJECT (AR)                           AREA:  OYSTER LAKE (24)
STATION:  EQUIDISTANT 3 SHORES-NW END; DEPTH 3.0M                                                   DATE:  AUGUST 24, 1983
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (60)                                                        SUBSTATION:    1
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  BARRY RAIDIGC (21)
NOTE:  NOT APPLICABLE (0)

                                                  RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
          GENUS/SPECIES                                  REPLICATES        COUNTS                               TOTAL FOR SP.

  AMPHIPODA
      GAMMARIDAE
          GAMMARUS LACUSTRIS (41326)
  NEMATODA                                                 1 - 3      0.       1.       0.
                                                                                                                    1.
          NEMATODA - ALL (50610)
  OLIGOCHAETA                                              1 - 3      8.       5.       4.
      NAIDIDAE                                                                                                     17.
          NAIDIDAE - ALL (59020)
          NAIS SPP. (59021)                                1 - 3      1.       1.       0.
          UNCINAIS UNCINATA (59025)                        1 - 3      3.       0.       2.                          2.
      LUMBRICULIDAE                                        1 - 3      0.       0.       3.                          5.
          LUMBRICULIDAE - ALL (59040)                                                                               3.
      TUBIFICIDAE                                          1 - 3      1.       0.       0.
          IMMATURE TUBIFICIDAE - W.C.C. (60010)                                                                     1.
      ENCHYTRAEIDAE                                        1 - 3      0.       2.       3.
          ENCHYTRAEIDAE - ALL (61000)                                                                               5.
  HIRUDINEA                                                1 - 3      3.       6.       0.
      ERPOBDELLIDAE                                                                                                 9.
          NEPHELOPSIS OBSCURA (62532)
  PELECYPODA                                               1 - 3      1.       0.       0.
      SPHAERIIDAE                                                                                                   1.
          PISIDIUM SP. (65025)
                                                           1 - 3     22.      15.      14.
                                                                                                                   51.

              TOTAL FOR  20 SPECIES BY REPLICATE:          1 - 3    265.     456.     482.

              TOTAL FOR   3 REPLICATES,  20 SPECIES:               1203.
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PROJECT:  ACID RAIN PROJECT (AP)                       AREA:  OYSTER LAKE (24)
STATION:  EQUIDISTANT 3 SHORES-ESE COVE; DEPTH 2.5M                                        DATE:  AUGUST 24, 1983
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (60)                                               SUBSTATION:    2
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NOT APPLICABLE (0)

                                              RAW DATA TABLES

 1ST LEVEL REFERENCE
     2ND LEVEL REFERENCE                                 REPLICATES          COUNTS                          TOTAL FOR SP.
          GENUS/SPECIES

EPHEMEROPTERA
     BAETIDAE
          CALLIBAETIS COLORADENSIS (1712)                  1 - 3       1.        2.        0.                          3.
     CAENIDAE
          CAENIS SP. (2710)                                1 - 3       2.        3.        0.                          5.
DIPTERA
     CHIRONOMIDAE, S-FAMILY TANYPODINAE
          PROCLADIUS SP. (10950)                           1 - 3      17.       11.       10.                         38.
     CHIRONOMIDAE, TRIBE CHIRONOMINI
          DICROTENDIPES SP. (12410)                        1 - 3      73.       38.       78.                        189.
          MICROTENDIPES SP. 1 (12925)                      1 - 3      12.        4.        2.                         18.
          PSEUDOCHIRONOMUS SP. (13250)                     1 - 3      66.       69.        0.                        135.
          PAGASTIELLA SP. (13350)                          1 - 3      13.       16.        7.                         36.
     CHIRONOMIDAE, TRIBE TANYTARSINI
          TANYTARSUS SP. (13700)                           1 - 3      86.       48.       89.                        223.
          LENZIELLA SP. (13990)                            1 - 3       4.        4.        3.                         11.
     CERATOPOGONIDAE
          PALPOMYIA SP. (18030)                            1 - 3       5.        8.       10.                         23.
OSTRACODA
     CYPRIDAE
          EUCYPRIS AFFINIS HIRSUTA (33900)                 1 - 3       2.        0.        0.                          2.
COPEPODA
     CALANOIDA
          DIAPTOMUS SHOSHONE (37061)                       1 - 3       1.        0.        0.                          1.
     CYCLOPOIDA
          MACROCYCLOPS ALBIDUS (38110)                     1 - 3       2.        0.        0.                          2.
AMPHIPODA
     TALITRIDAE
          HYALELLA AZTECA (41060)                          1 - 3       3.        6.        5.                         14.
     GAMMARIDAE
          GAMMARUS LACUSTRIS (41320)                       1 - 3       2.        1.        2.                          5.
NEMATODA

          NEMATODA - ALL (50610)                           1 - 3      13.        3.        1.                         17.
OLIGOCHAETA
     NAIDIDAE
          NAIDIDAE - ALL (59020)                           1 - 3       0.        0.        2.                          2.
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PROJECT:  ACID RAIN PROJECT (AR)                           AREA:  OYSTER LAKE (24)                         DATE:  AUGUST 24, 1983
STATION:  EQUIDISTANT 3 SHORES-ESE COVE; DEPTH 2.5M                                                         SUBSTATION:   2
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (60)
NUMBER OF REPLICATES:   3      FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NOT APPLICABLE (0)

                                                  RAW DATA TABLES

   1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE
           GENUS/SPECIES                                    REPLICATES          COUNTS                            TOTAL FOR SP.

   OLIGOCHAETA
       NAIDIDAE
           NAIS SPP. (89021)                                 1 - 3       1.      1.       6.                             8.
       ENCHYTRAEIDAE
           ENCHYTRAEIDAE - ALL (81000)                       1 - 3       2.     14.       9.                            25.
   HIRUDINEA
       ERPOBDELLIDAE
           NEPHELOPSIS OBSCURA (62532)                       1 - 3       1.      5.       0.                             6.
   PELECYPODA
       SPHAERIIDAE
           PISIDIUM SP. (65025)                              1 - 3      21.     12.       4.                            37.


                    TOTAL FOR  21 SPECIES BY REPLICATE:      1 - 3     327.    245.     228.

                    TOTAL FOR   3 REPLICATES,  21 SPECIES:             800.
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PROJECT:  ACID RAIN PROJECT (AP)                    AREA:  UPPER ISLAND LAKE (25)                    DATE:  AUGUST 27, 1983
STATION:  MIDWAY INFLOW TO ISLAND; DEPTH 3.5M                                                         SUBSTATION:   4
SAMPLER TYPE:  ECKMAN DREDGE BOTTOM GRAB (60)
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NOT APPLICABLE (0)


                                                   RAW DATA TABLES

  1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE                                  REPLICATES            COUNTS                              TOTAL FOR SP.
            GENUS/SPECIES

  DIPTERA
       CHIRONOMIDAE, S-FAMILY TANYPODINAE
            PROCLADIUS SP. (10950)                           1 - 3       8.         6.        11.                                 25.
       CHIRONOMIDAE, TRIBE CHIRONOMINI
            CHIRONOMUS SP. 1 (12255)                         1 - 3       0.         0.         1.                                  1.
            CHIRONOMUS SP. 2 (12256)                         1 - 3      42.        53.        54.                                149.
       CHIRONOMIDAE, TRIBE TANYTARSINI
            CORYNOCERA SP. (13900)                           1 - 3       1.         1.         0.                                  2.
       CHIRONOMIDAE, S-FAM ORTHOCLADIINAE
            PSECTROCLADIUS SP. 2 (15601)                     1 - 3       0.         1.         0.                                  1.
  OSTRACODA
       CYPRIDAE
            CANDONA SCOPULOSA (33600)                        1 - 3       0.         0.         1.                                  1.
  OLIGOCHAETA
       TUBIFICIDAE
            IMMATURE TUBIFICIDAE - W.C.C.C. (60000)          1 - 3      93.        92.        18.                                203.
            IMMATURE TUBIFICIDAE - W.C.C. (60010)            1 - 3      25.        17.        53.                                 95.
            LIMNODRILUS HOFFMEISTERI (SPIRALIS FORM) (60020) 1 - 3      17.         8.        24.                                 49.


                 TOTAL FOR   9 SPECIES BY REPLICATE:         1 - 3     186.       178.       162.


                 TOTAL FOR   3 REPLICATES,   9 SPECIES:                526.
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APPENDIX F. RAW QUALITATIVE INVERTEBRATE SAMPLE DATA FROM COLORADO FLAT TOPS STUDY LAKES, 1982.

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                                                                                                   PAGE  1

PROJECT:  ACID RAIN PROJECT (AR)                   AREA:  NED WILSON LAKE (23)                    DATE:  AUGUST 17, 1982
STATION:  SHORELINE/LITTORAL TO 1 M DEPTH                                                         SUBSTATION:    9
SAMPLER TYPE:  QUALITATIVE DIP NET SAMPLE (40)
NUMBER OF REPLICATES:   5     FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                    RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
          GENUS/SPECIES                                   REPLICATES          COUNTS                                  TOTAL FOR SP.

  ODONATA-ZYGOPTERA
      COENAGRIONIDAE
          ENALLAGMA BOREALE (5402)                         1 - 5      0.      1.      0.      0.      0.         1.
  TRICHOPTERA
      LIMNEPHILIDAE
          PSYCHOGLYPHA SUBBOREALIS (9600)                  1 - 5      0.      9.      1.      2.      0.        12.
  DIPTERA
      CHIRONOMIDAE, S-FAMILY TANYPODINAE
          PROCLADIUS SP. (10950)                           1 - 5      0.      1.      9.      1.      0.        11.
      CHIRONOMIDAE, TRIBE CHIRONOMINI
          DICROTENDIPES SP. (12410)                        1 - 5      0.      0.      1.      0.      0.         1.
          PAGASTIELLA SP. (13350)                          1 - 5      0.      0.      1.      0.      0.         1.
          CLADOPELMA SP. (13400)                           1 - 5      0.      0.      0.      1.      0.         1.
      CHIRONOMIDAE, TRIBE TANYTARSINI
          TANYTARSUS SP. (13700)                           1 - 5      0.      0.      1.      0.      0.         1.
          CORYNOCERA SP. (13900)                           1 - 5      0.     20.      1.      5.      0.        26.
          LENZIELLA SP. (13990)                            1 - 5      0.      0.      0.      2.      0.         2.
      CHIRONOMIDAE, S-FAM ORTHOCLADIINAE
          CORYNONEURA SP (14415)                           1 - 5      3.      0.      5.      4.      0.        12.
          HETEROTRISSOCLADIUS SP. (14810)                  1 - 5      0.      0.      1.      0.      0.         1.
          PARAMETRIOCNEMUS SP. (15100)                     1 - 5      0.      0.      1.      1.      0.         2.
          PSECTROCLADIUS SP. 1 (15600)                     1 - 5      3.      5.      0.      1.      0.         9.
          SYNORTHOCLADIUS SP. (16010)                      1 - 5      0.      1.      0.      1.      0.         2.
      CERATOPOGONIDAE
          PALPOMYIA SP. (18030)                            1 - 5      0.      2.      3.      1.      0.         6.
  COLEOPTERA
      DYTISCIDAE
          DERONECTES GRISEOSTRIATUS (20483)                1 - 5      0.      2.      0.      0.      0.         2.
  OLIGOCHAETA
      NAIDIDAE
          NAIS SPP. (59021)                                1 - 5      0.      2.      0.      0.      0.         2.
          UNCINAIS UNCINATA (59025)                        1 - 5      0.      8.      1.      0.      1.        10.
      LUMBRICULIDAE
          LUMBRICULIDAE - ALL (59040)                      1 - 5      6.     10.      5.      2.      1.        24.
      TUBIFICIDAE
          IMMATURE TUBIFICIDAE - W.C.C.C. (60000)          1 - 5      0.      0.      0.      0.      7.         7.
```

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PROJECT:  ACID RAIN PROJECT (AP)                    AREA:  NED WILSON LAKE (23)                    DATE:  AUGUST 17, 1982
STATION:  SHORELINE/LITTORAL TO 1 M DEPTH                                                          SUBSTATION:    9
SAMPLER TYPE:  QUALITATIVE DIP NET SAMPLE (40)
NUMBER OF REPLICATES:   5     FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                   RAW DATA TABLES

  1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE
            GENUS/SPECIES                                      REPLICATES            COUNTS                           TOTAL FOR SP.

  OLIGOCHAETA
       TUBIFICIDAE
            IMMATURE TUBIFICIDAE - W.C.C. (60010)              1 - 5       0.       0.       0.       0.       1.        1.
            LIMNODRILUS HOFFMEISTERI (SPIRALIS FORM) (60020)   1 - 5       0.       0.       0.       0.       4.        4.
  HIRUDINEA
       GLOSSIPHONIIDAE
            HELOBDELLA STAGNALIS (62610)                       1 - 5       3.       0.       1.       1.       0.        5.
  PELECYPODA
       SPHAERIIDAE
            PISIDIUM SP. (65025)                               1 - 5       6.      16.       5.       6.       0.       33.


                 TOTAL FOR  24 SPECIES BY REPLICATE:           1 - 5      21.      77.      36.      28.      14.

                 TOTAL FOR   5 REPLICATES,  24 SPECIES:                  176.
```

```
PROJECT:  ACID RAIN PROJECT (AP)                     AREA:  OYSTER LAKE (24)                          DATE:  AUGUST 18, 1982
STATION:  SHORELINE/LITTORAL TO 1 M DEPTH                                                              SUBSTATION:    9
SAMPLER TYPE:  QUALITATIVE DIP NET SAMPLE (40)
NUMBER OF REPLICATES:   2     FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                   RAW DATA TABLES

    1ST LEVEL REFERENCE
         2ND LEVEL REFERENCE                                        REPLICATES          COUNTS                      TOTAL FOR SP.
              GENUS/SPECIES

    EPHEMEROPTERA
         CAENIDAE
              CAENIS SP. (2710)                                     1 - 2       6.      2.
    ODONATA-ZYGOPTERA                                                                                                          8.
         COENAGRIONIDAE
              ENALLAGMA BOREALE (9402)                              1 - 2       0.      1.
    HEMIPTERA                                                                                                                  1.
         CORIXIDAE
              ARCTOCORISA SUTILIS (6011)                            1 - 2      19.      6.
    TRICHOPTERA                                                                                                               25.
         LIMNEPHILIDAE
              LIMNEPHILUS EXTERNUS (9563)                           1 - 2       1.      0.
              LIMNEPHILUS SP. (9567)                                1 - 2       0.      2.                                     1.
              PSYCHOGLYPHA SUBBOREALIS (9600)                       1 - 2       4.      1.                                     2.
    DIPTERA                                                                                                                    5.
         CHIRONOMIDAE, TRIBE CHIRONOMINI
              DICROTENDIPES SP. (12410)                             1 - 2       0.      2.
              PSEUDOCHIRONOMUS SP. (13250)                          1 - 2       3.      2.                                     2.
              STICTOCHIRONOMUS SP. (13300)                          1 - 2       8.      0.                                     5.
         CHIRONOMIDAE, TRIBE TANYTARSINI                                                                                       8.
              TANYTARSUS SP. (13700)                                1 - 2      15.      0.
              PARATANYTARSUS SP. (13750)                            1 - 2       1.      0.                                    15.
              LENZIELLA SP. (13990)                                 1 - 2       2.      0.                                     1.
         CHIRONOMIDAE, S-FAM ORTHOCLADIINAE                                                                                    2.
              PSECTROCLADIUS SP. 1 (15600)                          1 - 2       1.      0.
    COLEOPTERA                                                                                                                 1.
         DYTISCIDAE
              ACILIUS ABBREVIATUS (20351)                           1 - 2       1.      0.
              ILYBIUS SP. (20469)                                   1 - 2       0.      1.                                     1.
              DERONECTES GRISEOSTRIATUS (20483)                     1 - 2       7.      4.                                     1.
    HYDRACARINA                                                                                                               11.
         LIMNESIIDAE
              LIMNESIA SP. (21770)                                  1 - 2       0.      2.
    COPEPODA                                                                                                                   2.
         CALANOIDA
              DIAPTOMUS SHOSHONE (37061)                            1 - 2       8.      0.
                                                                                                                               8.
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PROJECT:  ACID RAIN PROJECT (AP)                          AREA:  OYSTER LAKE (24)                  DATE:  AUGUST 18, 1982
STATION:  SHORELINE/LITTORAL TO 1 M DEPTH                                                          SUBSTATION:    9
SAMPLER TYPE:  QUALITATIVE DIP NET SAMPLE (40)
NUMBER OF REPLICATES:    2      FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                     RAW DATA TABLES

   1ST LEVEL REFERENCE
        2ND LEVEL REFERENCE
             GENUS/SPECIES                                  REPLICATES           COUNTS
                                                                                                              TOTAL FOR SP.
   AMPHIPODA
        TALITRIDAE
             HYALELLA AZTECA (41080)
        GAMMARIDAE                                           1 - 2        6.        3.
             GAMMARUS LACUSTRIS (41326)                                                                           9.
   NEMATODA                                                  1 - 2        1.        2.
                                                                                                                  3.
             NEMATODA - ALL (50810)
   OLIGOCHAETA                                               1 - 2        1.        0.
        NAIDIDAE                                                                                                  1.
             NAIS SPP. (59021)
   HIRUDINEA                                                 1 - 2        1.        0.
        ERPOBDELLIDAE                                                                                             1.
             NEPHELOPSIS OBSCURA (62532)
   PELECYPODA                                                1 - 2        6.        1.
        SPHAERIIDAE                                                                                               7.
             PISIDIUM SP. (68095)
                                                             1 - 2        7.        1.
                                                                                                                  8.

                  TOTAL FOR  24 SPECIES BY REPLICATE:        1 - 2       98.       30.

                  TOTAL FOR   2 REPLICATES,  24 SPECIES:                128.
```

```
PROJECT:  ACID RAIN PROJECT (AP)
STATION:  SHORELINE/LITTORAL TO 1 M DEPTH          AREA:  UPPER ISLAND LAKE (29)                    DATE:  AUGUST 20, 1982
SAMPLER TYPE:  QUALITATIVE DIP NET SAMPLE (40)                                                       SUBSTATION:     9
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  DENNIS WELSCH (89)
NOTE:  NOT APPLICABLE (0)

                                              RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
          GENUS/SPECIES                               REPLICATES          COUNTS                             TOTAL FOR SP.

  DIPTERA
      CHIRONOMIDAE, S-FAMILY TANYPODINAE
          PROCLADIUS SP. (10950)                      1 - 3      0.        1.        2.                          3.
      CHIRONOMIDAE, TRIBE TANYTARSINI
          PARATANYTARSUS SP. (13780)                  1 - 3      1.        1.        1.                          3.
          CORYNOCERA SP. (13500)                      1 - 3      0.        1.        0.                          1.
      CHIRONOMIDAE, S-FAM ORTHOCLADIINAE
          CORYNONEURA SP (14415)                      1 - 3     10.        1.        0.                         11.
          CRICOTOPUS/ORTHOCLADIUS (14470)             1 - 3      0.        1.        0.                          1.
          PSECTROCLADIUS SP. 1 (15600)                1 - 3     18.        0.        0.                         18.
          SYNORTHOCLADIUS SP. (16010)                 1 - 3      1.        0.        0.                          1.
      CHIRONOMIDAE, TRIBE DIAMESINAE
          PSEUDODIAMESA SP. (16500)                   1 - 3      1.        0.        0.                          1.
  COLEOPTERA
      DYTISCIDAE
          HYDROPORUS SP. 1 (20460)                    1 - 3      3.        0.        0.                          3.
          DERONECTES GRISEOSTRIATUS (20483)           1 - 3      3.        0.        0.                          3.
  HYDRACARINA
      LEBERTIIDAE
          LEBERTIA SP. (21410)                        1 - 3      0.        6.        0.                          6.
      HYGROBATIDAE
          HYGROBATES SP. (21710)                      1 - 3      1.        0.        1.                          2.
  NEMATODA

          NEMATODA - ALL (50610)                      1 - 3      5.        0.        1.                          6.
  OLIGOCHAETA
      LUMBRICULIDAE
          LUMBRICULIDAE - ALL (89040)                 1 - 3      0.        0.        3.                          3.


              TOTAL FOR  14 SPECIES BY REPLICATE:     1 - 3     43.       11.        8.

              TOTAL FOR   3 REPLICATES,  14 SPECIES:            62.
```

APPENDIX G. RAW QUALITATIVE INVERTEBRATE SAMPLE DATA FROM COLORADO FLAT TOPS STUDY LAKES, 1983.

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                                                                                                   PAGE  1

PROJECT:  ACID RAIN PROJECT (AR)                    AREA:  NED WILSON LAKE (23)                    DATE:  AUGUST 25, 1983
STATION:  SHORELINE/LITTORAL TO 1 M DEPTH                                                           SUBSTATION:     0
SAMPLER TYPE:  QUALITATIVE DIP NET SAMPLE (40)
NUMBER OF REPLICATES:   4     FIELD BIOLOGIST:  DENNIS WELSCH (59)
NOTE:  NOT APPLICABLE (0)

                                                    RAW DATA TABLES

 1ST LEVEL REFERENCE
     2ND LEVEL REFERENCE                                          REPLICATES          COUNTS                              TOTAL FOR SP.
          GENUS/SPECIES

 EPHEMEROPTERA
     BAETIDAE
          CALLIBAETIS COLORADENSIS (1712)                          1 - 4       0.       3.       2.       0.                    5.
 TRICHOPTERA
     LIMNEPHILIDAE
          IMMATURE LIMNEPHILIDAE (9568)                            1 - 4       0.       3.      12.       0.                   15.
          PSYCHOGLYPHA SUBBOREALIS (9600)                          1 - 4       0.       0.       4.       3.                    7.
 DIPTERA
     CHIRONOMIDAE, S-FAMILY TANYPODINAE
          ABLABESMYIA SP. (10621)                                  1 - 4       0.       1.       0.       0.                    1.
          PROCLADIUS SP. (10950)                                   1 - 4       5.       9.       2.       5.                   21.
     CHIRONOMIDAE, TRIBE CHIRONOMINI
          MICROTENDIPES SP. 1 (12525)                              1 - 4       2.       5.       1.       8.                   16.
          MICROTENDIPES SP.2 (12526)                               1 - 4       0.       2.       0.       1.                    3.
          CLADOPELMA SP. (13400)                                   1 - 4       1.       0.       0.       0.                    1.
     CHIRONOMIDAE, TRIBE TANYTARSINI
          TANYTARSUS SP. (13700)                                   1 - 4       1.       2.       2.       0.                    5.
          PARATANYTARSUS SP. (13750)                               1 - 4       3.       1.       4.      26.                   34.
     CHIRONOMIDAE, S-FAM ORTHOCLADIINAE
          CORYNONEURA SP (14415)                                   1 - 4       3.      12.       4.       0.                   19.
          CRICOTOPUS FLAVOCINCTUS (14510)                          1 - 4       0.       1.       2.       0.                    3.
          HETEROTRISSOCLADIUS SP. (14810)                          1 - 4       0.       0.       1.       0.                    1.
     CHIRONOMIDAE, TRIBE DIAMESINAE
          PSEUDOKIEFFERIELLA SP. (16505)                           1 - 4      10.       2.       1.       0.                   13.
     CERATOPOGONIDAE
          PALPOMYIA SP. (18030)                                    1 - 4       0.       0.       0.       3.                    3.
 COLEOPTERA
     DYTISCIDAE
          HYDROVATUS SP. (20380)                                   1 - 4       0.       0.       5.       0.                    5.
          AGABUS SP. 2 (20457)                                     1 - 4       0.       0.       2.       0.                    2.
          AGABUS SP. 3 (20458)                                     1 - 4       0.       0.       1.       0.                    1.
          HYDROPORUS SP. 2 (20461)                                 1 - 4       0.       0.       1.       0.                    1.
          DERONECTES GRISEOSTRIATUS (20483)                        1 - 4       0.       0.       3.       5.                    8.
     HYDROPHILIDAE
          HELOPHORUS SP. (20820)                                   1 - 4       0.       0.       1.       0.                    1.
```

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PROJECT:  ACID RAIN PROJECT (AR)                    AREA:  RED WILSON LAKE (23)                        DATE:  AUGUST 25, 1983
STATION:  SHORELINE/LITTORAL TO 1 M DEPTH                                                              SUBSTATION:    9
SAMPLER TYPE:  QUALITATIVE DIP NET SAMPLE (40)
NUMBER OF REPLICATES:   4     FIELD BIOLOGIST:  DENNIS NELSON (99)
NOTE:  NOT APPLICABLE (0)


                                               RAW DATA TABLES

   1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE                                     REPLICATES         COUNTS                              TOTAL FOR SP.
           GENUS/SPECIES

  HYDRACARINA
       LEBERTIIDAE
           LEBERTIA SP. (21410)                                  1 - 4       0.      1.      3.      2.                     6.
  CLADOCERA
       DAPHNIIDAE
           DAPHNIA PULEX (31790)                                 1 - 4       0.      0.      0.      1.                     1.
           SCAPHOLEBERIS KINGI (31850)                           1 - 4       0.      1.      0.      0.                     1.
  OSTRACODA
       CYPRIDAE
           CANDONA SCOPULOSA (33600)                             1 - 4       0.      1.      0.      0.                     1.
  COPEPODA
       CALANOIDA
           DIAPTOMUS COLORADENSIS (37059)                        1 - 4       0.      0.      1.      0.                     1.
           DIAPTOMUS SHOSHONE (37061)                            1 - 4       0.      0.      0.      3.                     3.
       CYCLOPOIDA
           MACROCYCLOPS ALBIDUS (38110)                          1 - 4       1.      1.      5.      0.                     7.
  NEMATODA

           NEMATODA - ALL (50610)                                1 - 4       0.      9.      0.      0.                     9.
  OLIGOCHAETA
       NAIDIDAE
           UNCINAIS UNCINATA (59025)                             1 - 4       0.      0.      1.      0.                     1.
       LUMBRICULIDAE
           LUMBRICULIDAE - ALL (59040)                           1 - 4      14.      7.      2.      9.                    32.
       TUBIFICIDAE
           LIMNODRILUS HOFFMEISTERI (SPIRALIS FORM) (60020)      1 - 4       0.      0.      0.      1.                     1.
       ENCHYTRAEIDAE
           ENCHYTRAEIDAE - ALL (61000)                           1 - 4       0.      1.      0.      0.                     1.
  HIRUDINEA
       GLOSSIPHONIIDAE
           HELOBDELLA STAGNALIS (63610)                          1 - 4      13.      3.      0.      3.                    19.
  PELECYPODA
       SPHAERIIDAE
           PISIDIUM SP. (65025)                                  1 - 4       6.      5.      0.      1.                    12.
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                                                                                                   PAGE  3
PROJECT:  ACID RAIN PROJECT (AP)                    AREA:  NED WILSON LAKE (23)                  DATE:  AUGUST 25, 1983
STATION:  SHORELINE/LITTORAL TO 1 M DEPTH                                                        SUBSTATION:    9
SAMPLER TYPE:  QUALITATIVE DIP NET SAMPLE (40)
NUMBER OF REPLICATES:   4     FIELD BIOLOGIST:  DENNIS NELSON (59)
NOTE:  NOT APPLICABLE (0)

                                                 RAW DATA TABLES

   1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE
           GENUS/SPECIES                             REPLICATES            COUNTS                          TOTAL FOR SP.

                  TOTAL FOR  35 SPECIES BY REPLICATE:      1 -  4      62.      70.      60.      67.

                  TOTAL FOR   4 REPLICATES,  35 SPECIES:             259.
```

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                                                                                                        PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                          AREA:  OYSTER LAKE (24)
STATION:  SHORELINE/LITTORAL TO 1 M DEPTH                                                       DATE:  AUGUST 24, 1983
SAMPLER TYPE:  QUALITATIVE DIP NET SAMPLE (40)                                                   SUBSTATION:    9
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  DENNIS NELSON (59)
NOTE:  NOT APPLICABLE (0)

                                              RAW DATA TABLES

   1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE
            GENUS/SPECIES                                    REPLICATES          COUNTS                         TOTAL FOR SP.

   EPHEMEROPTERA
       BAETIDAE
            CALLIBAETIS COLORADENSIS (1712)                   1 -  3       0.       32.      27.                       59.
            CLOEON INGENS (1812)                              1 -  3       0.        3.       0.                        3.
       CAENIDAE
            CAENIS SP. (2710)                                 1 -  3       0.        2.       1.                        3.
   ODONATA-ZYGOPTERA
       COENAGRIONIDAE
            ENALLAGMA BOREALE (5402)                          1 -  3       0.        2.       1.                        3.
   HEMIPTERA
       CORIXIDAE
            ARCTOCORISA SUTILIS (6011)                        1 -  3       0.        2.      21.                       23.
       GERRIDAE
            GERRIS SP. (6110)                                 1 -  3       0.        5.       1.                        6.
   TRICHOPTERA
       LIMNEPHILIDAE
            LIMNEPHILUS EXTERNUS (9563)                       1 -  3       0.        1.       0.                        1.
            PSYCHOGLYPHA SUBBOREALIS (9600)                   1 -  3       3.        0.       4.                        7.
   DIPTERA
       CHIRONOMIDAE, S-FAMILY TANYPODINAE
            PROCLADIUS SP. (10950)                            1 -  3       0.       30.      27.                       57.
       CHIRONOMIDAE, TRIBE CHIRONOMINI
            CRYPTOCHIRONOMUS SP. (12390)                      1 -  3       0.        0.       2.                        2.
            DICROTENDIPES SP. (12410)                         1 -  3       0.        2.       1.                        3.
            MICROTENDIPES SP. 1 (12525)                       1 -  3       0.        0.       1.                        1.
            PSEUDOCHIRONOMUS SP. (13250)                      1 -  3       1.       45.      29.                       75.
            STICTOCHIRONOMUS SP. (13300)                      1 -  3       0.       22.       2.                       24.
            PAGASTIELLA SP. (13350)                           1 -  3       0.        1.       0.                        1.
       CHIRONOMIDAE, TRIBE TANYTARSINI
            TANYTARSUS SP. (13700)                            1 -  3       0.       12.      23.                       35.
            PARATANYTARSUS SP. (13750)                        1 -  3       1.        1.       0.                        2.
            LENZIELLA SP. (13990)                             1 -  3       0.        1.       0.                        1.
       CHIRONOMIDAE, S-FAM ORTHOCLADIINAE
            CORYNONEURA SP (14415)                            1 -  3       1.        9.       6.                       16.
            CRICOTOPUS SPP. (14460)                           1 -  3       0.        0.       1.                        1.
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PROJECT:  ACID RAIN PROJECT (AR)                     AREA:  OYSTER LAKE (24)                                DATE:  AUGUST 24, 1983
STATION:  SHORELINE/LITTORAL TO 1 M DEPTH                                                                   SUBSTATION:    9
SAMPLER TYPE:  QUALITATIVE DIP NET SAMPLE (4C)
NUMBER OF REPLICATES:    3     FIELD BIOLOGIST:  DENNIS NELSON (59)
NOTE:  NOT APPLICABLE (0)

                                                RAW DATA TABLES

    1ST LEVEL REFERENCE
         2ND LEVEL REFERENCE
              GENUS/SPECIES                                    REPLICATES           COUNTS                          TOTAL FOR SP.

    DIPTERA
         CHIRONOMIDAE, S-FAM ORTHOCLADIINAE
              CRICOTOPUS FLAVOCINCTUS (14510)                  1 -  3      1.       0.       0.                              1.
              PARAMETRIOCNEMUS SP. (15100)                     1 -  3      0.       1.       0.                              1.
              PSECTROCLADIUS SP. 1 (15600)                     1 -  3      0.       0.       5.                              5.
         CERATOPOGONIDAE
              PALPOMYIA SP. (18030)                            1 -  3      0.       1.       1.                              2.
         SYRPHIDAE
              ERISTALIS SP. (18160)                            1 -  3      0.       0.       1.                              1.
    COLEOPTERA
         DYTISCIDAE
              RHANTUS SP. (20416)                              1 -  3      0.       1.       4.                              5.
              DYTISCUS SP. (20445)                             1 -  3      0.       1.       0.                              1.
              AGABUS SP.   (20455)                             1 -  3      0.       2.       3.                              5.
              ILYBIUS SP. (20465)                              1 -  3      0.       0.       2.                              2.
              DEPRONECTES GRISEOSTRIATUS (20483)               1 -  3      0.       7.       6.                             13.
    HYDRACARINA
         LEBERTIIDAE
              LEBERTIA SP. (21410)                             1 -  3      0.       0.       1.                              1.
         ARRENURIDAE
              ARRENURUS SP. (21600)                            1 -  3      0.       4.       2.                              6.
         PIONIDAE
              PIONA SP. (21735)                                1 -  3      0.       0.       4.                              4.
         LIMNESIIDAE
              LIMNESIA SP. (21770)                             1 -  3      0.       5.       4.                              9.
    CLADOCERA
         DAPHNIIDAE
              DAPHNIA PULEX (31790)                            1 -  3      0.       6.       1.                              7.
    COPEPODA
         CALANOIDA
              DIAPTOMUS COLORADENSIS (37059)                   1 -  3      0.      16.      24.                             40.
              DIAPTOMUS SHOSHONE (37061)                       1 -  3      0.       8.       1.                              9.
    AMPHIPODA
         TALITRIDAE
              HYALELLA AZTECA (41060)                          1 -  3      1.      29.       9.                             39.
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                                                                                                   PAGE  3
PROJECT:  ACID RAIN PROJECT (AP)                              AREA:  OYSTER LAKE (24)
STATION:  SHORELINE/LITTORAL TO 1 M DEPTH                                                        DATE:  AUGUST 24, 1983
SAMPLER TYPE:  QUALITATIVE DIP NET SAMPLE (40)                                                   SUBSTATION:    9
NUMBER OF REPLICATES:    3      FIELD BIOLOGIST:  DENNIS NELSON (59)
NOTE:  NOT APPLICABLE (0)

                                                           RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                        REPLICATES              COUNTS                           TOTAL FOR SP.
          GENUS/SPECIES

 AMPHIPODA
      GAMMARIDAE
          GAMMARUS LACUSTRIS (41326)                              1 - 3         0.        36.        3.                          39.
 OLIGOCHAETA
      NAIDIDAE
          NAIS SPP. (59021)                                       1 - 3         9.         0.        0.                           9.
          UNCINAIS UNCINATA (59025)                               1 - 3         0.         0.        2.                           2.
      LUMBRICULIDAE
          LUMBRICULIDAE - ALL (59040)                             1 - 3         0.         1.        0.                           1.
 HIRUDINEA
      ERPOBDELLIDAE
          MOOREOBDELLA OBSCURA (62532)                            1 - 3         0.         2.        1.                           3.
      GLOSSIPHONIIDAE
          GLOSSIPHONIA COMPLANATA (62590)                         1 - 3         0.         3.        0.                           3.
 PELECYPODA
      SPHAERIIDAE
          PISIDIUM SP. (65025)                                    1 - 3         0.         7.        7.                          14.


                TOTAL FOR  45 SPECIES BY REPLICATE:               1 - 3        17.       300.      228.

                TOTAL FOR   3 REPLICATES,  45 SPECIES:                        545.
```

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                                                                                                        PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                     AREA:  UPPER ISLAND LAKE (25)                DATE:  AUGUST 27, 1983
STATION:  SHORELINE/LITTORAL TO 1 M DEPTH                                                          SUBSTATION:    9
SAMPLER TYPE:  QUALITATIVE DIP NET SAMPLE (40)
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  DENNIS NELSON (59)
NOTE:  NOT APPLICABLE (0)

                                                  RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE                                    REPLICATES          COUNTS                          TOTAL FOR SP.
          GENUS/SPECIES

  HEMIPTERA
      CORIXIDAE
          CENOCORIXA WILEYAE (6015)                           1 - 3      0.       0.       1.                         1.
  TRICHOPTERA
      LIMNEPHILIDAE
          IMMATURE LIMNEPHILIDAE (9568)                       1 - 3      0.       0.       1.                         1.
          PSYCHOGLYPHA SUBBOREALIS (9600)                     1 - 3      0.       1.       3.                         4.
  DIPTERA
      CHIRONOMIDAE, S-FAMILY TANYPODINAE
          PROCLADIUS SP. (10950)                              1 - 3      1.      10.       4.                        15.
      CHIRONOMIDAE, TRIBE TANYTARSINI
          PARATANYTARSUS SP. (13750)                          1 - 3      0.       1.       1.                         2.
      CHIRONOMIDAE, S-FAM ORTHOCLADIINAE
          CRICOTOPUS/ORTHOCLADIUS (14470)                     1 - 3      0.       0.       2.                         2.
          SYNORTHOCLADIUS SP. (16010)                         1 - 3      0.       0.       2.                         2.
  COLEOPTERA
      DYTISCIDAE
          RHANTUS SP. (20416)                                 1 - 3      0.       1.       0.                         1.
          HYDROPORUS SP. 1 (20460)                            1 - 3     14.       0.       1.                        15.
          DERONECTES GRISEOSTRIATUS (20483)                   1 - 3      0.       0.       3.                         3.
  HYDRACARINA
      LEBERTIIDAE
          LEBERTIA SP. (21410)                                1 - 3      1.       2.      15.                        18.
      HYGROBATIDAE
          HYGROBATES SP. (21710)                              1 - 3      0.       0.       1.                         1.
  OSTRACODA
      CYPRIDAE
          EUCYPRIS AFFINIS HIRSUTA (33900)                    1 - 3      0.       0.       4.                         4.
  COPEPODA
      CALANOIDA
          DIAPTOMUS ARAPAHOENSIS (37060)                      1 - 3     23.      11.      16.                        50.
  OLIGOCHAETA

          OLIGOCHAETA - ALL (59010)                           1 - 3      1.       0.       0.                         1.
      LUMBRICULIDAE
          LUMBRICULIDAE - ALL (59040)                         1 - 3      0.      11.      46.                        57.
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                                                                                                   PAGE  2

PROJECT:  ACID RAIN PROJECT (AR)                  AREA:  UPPER ISLAND LAKE (25)                DATE:  AUGUST 27, 1983
STATION:  SHORELINE/LITTORAL TO 1 M DEPTH                                                       SUBSTATION:    9
SAMPLER TYPE:  QUALITATIVE DIP NET SAMPLE (40)
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  DENNIS NELSON (59)
NOTE:  NOT APPLICABLE (0)

                                                  RAW DATA TABLES

   1ST LEVEL REFERENCE
        2ND LEVEL REFERENCE                                     REPLICATES          COUNTS                     TOTAL FOR SP.
             GENUS/SPECIES

   HIRUDINEA
        GLOSSIPHONIIDAE
             HELOBDELLA STAGNALIS (62610)                         1 - 3       0.        7.        2.                        9.


                        TOTAL FOR  17 SPECIES BY REPLICATE:       1 - 3      40.       44.      102.

                        TOTAL FOR   3 REPLICATES,  17 SPECIES:              186.
```

APPENDIX H. INVERTEBRATE COUNTS FROM NED WILSON LAKE 10-ROCK, BASKET AND HESTER-DENDY AND UPPER ISLAND 10-ROCK SPECIAL SAMPLES.

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                                                                                                        PAGE  1

PROJECT:  ACID RAIN PROJECT (AR)                     AREA:  REP WILSON LAKE (23)                DATE:  AUGUST 26, 1983
STATION:  SHORELINE/LITTORAL TO 1 M DEPTH (239)                                                  SUBSTATION:    9
SAMPLER TYPE:  SC ROCKMETHOD; INDIVIDUAL SCRAPE
NUMBER OF REPLICATES:   3     FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NOT APPLICABLE (0)

                                                  RAW DATA TABLES

  1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE                                  REPLICATES            COUNTS                    TOTAL FOR SP.
            GENUS/SPECIES

  DIPTERA
       CHIRONOMIDAE, TRIBE CHIRONOMINI
            MICROTENDIPES SP. 1 (12925)                     1 - 3       1.        0.        3.                      4.
       CHIRONOMIDAE, TRIBE TANYTARSINI
            TANYTARSUS SP. (13700)                          1 - 3       3.        2.        0.                      5.
            PARATANYTARSUS SP. (13750)                      1 - 3     128.      104.      167.                    399.
       CHIRONOMIDAE, S-FAM ORTHOCLADIINAE
            CORYNONEURA SP (14415)                          1 - 3       0.        0.        1.                      1.
            SYNORTHOCLADIUS SP. (16010)                     1 - 3       0.        0.        1.                      1.
       CHIRONOMIDAE, TRIBE DIAMESINAE
            PSEUDOKIEFFERIELLA SP. (16505)                  1 - 3      58.       24.       13.                     95.
  COLEOPTERA
       DYTISCIDAE
            HYDROPORUS SP. 1 (20460)                        1 - 3       0.        1.        0.                      1.
  OSTRACODA
       CYPRIDAE
            CANDONA SCOPULOSA (33400)                       1 - 3       0.        1.        0.                      1.
  COPEPODA
       CYCLOPOIDA
            MACROCYCLOPS ALBIDUS (38110)                    1 - 3       3.        6.        0.                      9.
  NEMATODA

            NEMATODA - ALL (50610)                          1 - 3       1.        0.        0.                      1.
  PELECYPODA
       SPHAERIIDAE
            PISIDIUM SP. (65025)                            1 - 3       4.        0.        0.                      4.


                TOTAL FOR  11 SPECIES BY REPLICATE:         1 - 3     198.      138.      185.

                TOTAL FOR   3 REPLICATES,  11 SPECIES:              521.
```

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                                                                                                   PAGE  1

PROJECT:  ACID RAIN PROJECT (AR)                AREA:  NED WILSON LAKE (23)                     DATE:  AUGUST 29, 1983
STATION:  SHORELINE/LITTORAL 1C 1 M DEPTH (239)                                                  SUBSTATION:     9
SAMPLER TYPE:  RECTANGULAR BASKET 4X6X7.5 INCHES (20)
NUMBER OF REPLICATES:   5     FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NOT APPLICABLE (0)

                                                  RAW DATA TABLES

   1ST LEVEL REFERENCE
        2ND LEVEL REFERENCE                                    REPLICATES          COUNTS                              TOTAL FOR SP.
             GENUS/SPECIES

   DIPTERA
        CHIRONOMIDAE
             CHIRONOMIDAE - ALL (10810)                          1 - 5       0.       1.       4.       0.       0.        5.
        CHIRONOMIDAE, S-FAMILY TANYPODINAE
             ABLABESMYIA SP. (10621)                             1 - 5       1.       0.       0.       0.       0.        1.
             PROCLADIUS SP. (10950)                              1 - 5       1.       0.       0.       1.       0.        2.
        CHIRONOMIDAE, TRIBE CHIRONOMINI
             CHIRONOMUS SP. 1 (12255)                            1 - 5       0.       0.       0.       0.       1.        1.
             MICROTENDIPES SP. 1 (12525)                         1 - 5       0.       0.       0.       1.       0.        1.
        CHIRONOMIDAE, TRIBE TANYTARSINI
             TANYTARSUS SP. (13700)                              1 - 5       0.       0.       0.       2.       0.        2.
             PARATANYTARSUS SP. (13750)                          1 - 5       0.       0.       0.       1.       5.        6.
        CHIRONOMIDAE, S-FAM ORTHOCLADIINAE
             CORYNONEURA SP (14415)                              1 - 5       2.       0.       1.       0.       0.        3.
        CHIRONOMIDAE, TRIBE DIAMESINAE
             PSEUDOKIEFFERIELLA SP. (16505)                      1 - 5       0.       0.       0.       3.       0.        3.
   HYDRACARINA
        LEBERTIIDAE
             LEBERTIA SP. (21410)                                1 - 5       1.       0.       0.       1.       0.        2.
   CLADOCERA
        HOLOPEDIDAE
             HOLOPEDIUM GIBBERUM (31722)                         1 - 5       0.       0.       0.       0.       1.        1.
   COPEPODA
        CYCLOPOIDA
             MACROCYCLOPS ALBIDUS (38110)                        1 - 5       4.      20.      11.      20.       6.       61.
   OLIGOCHAETA
        LUMBRICULIDAE
             LUMBRICULIDAE - ALL (59040)                         1 - 5       1.       1.       0.       0.       0.        2.
   HIRUDINEA
        GLOSSIPHONIIDAE
             HELOBDELLA STAGNALIS (63610)                        1 - 5       0.       1.       3.       0.       0.        4.
   PELECYPODA
        SPHAERIIDAE
             PISIDIUM SP. (65025)                                1 - 5       0.       0.       1.       0.       0.        1.
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PROJECT:  ACID RAIN PROJECT (AR)                      AREA:  NED WILSON LAKE (23)                    DATE:  AUGUST 25, 1983
STATION:  SHORELINE/LITTORAL TO 1 M DEPTH (239)                                                       SUBSTATION:    9
SAMPLER TYPE:  RECTANGULAR BASKET 4X6X7.5 INCHES (20)
NUMBER OF REPLICATES:   5    FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NOT APPLICABLE (0)

                                                        RAW DATA TABLES

1ST LEVEL REFERENCE
   2ND LEVEL REFERENCE                                       REPLICATES           COUNTS                              TOTAL FOR SP.
        GENUS/SPECIES

                TOTAL FOR  15 SPECIES BY REPLICATE:           1 - 5      10.      23.      20.      29.      13.

                TOTAL FOR   5 REPLICATES,  15 SPECIES:                   95.
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                                                                                              PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                    AREA:  NED WILSON LAKE (23)
STATION:  SHORELINE/LITTORAL TO 1 M DEPTH (239)                                          DATE:  AUGUST 25, 1983
SAMPLER TYPE:  MULTIPLE PLATE SAMPLER - HESTER DENDY (17)                                 SUBSTATION:    9
NUMBER OF REPLICATES:    4      FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NOT APPLICABLE (0)

                                                 RAW DATA TABLES

  1ST LEVEL REFERENCE
      2ND LEVEL REFERENCE
          GENUS/SPECIES                                        REPLICATES        COUNTS                        TOTAL FOR SP.

  DIPTERA
      CHIRONOMIDAE
          CHIRONOMIDAE - ALL (10510)                           1 - 4      0.      1.      0.      0.                  1.
      CHIRONOMIDAE, TRIBE TANYTARSINI
          PARATANYTARSUS SP. (13750)                           1 - 4      8.      0.      0.      0.                  8.
      CHIRONOMIDAE, S-FAM ORTHOCLADIINAE
          CORYNONEURA SP (14415)                               1 - 4      3.      3.      1.      1.                  8.
  HIRUDINEA
      GLOSSIPHONIIDAE
          HELOBDELLA STAGNALIS (63610)                         1 - 4      1.      0.      0.      0.                  1.

                    TOTAL FOR   4 SPECIES BY REPLICATE:        1 - 4     12.      4.      1.      1.

                    TOTAL FOR   4 REPLICATES,   4 SPECIES:               18.
```

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PROJECT:  ACID RAIN PROJECT (AR)                     AREA:  UPPER ISLAND LAKE (25)                   DATE:  AUGUST 29, 1983
STATION:  SHORELINE/LITTORAL TO 1 M DEPTH (259)                                                      SUBSTATION:    9
SAMPLER TYPE:  1C ROCKMETHOD; INDIVIDUAL SCRAPE
NUMBER OF REPLICATES:   3      FIELD BIOLOGIST:  BARRY BALDIGO (21)
NOTE:  NOT APPLICABLE (0)

                                                     RAW DATA TABLES

    1ST LEVEL REFERENCE
        2ND LEVEL REFERENCE
            GENUS/SPECIES                                        REPLICATES          COUNTS                              TOTAL FOR SP.

    TRICHOPTERA
        LIMNEPHILIDAE
            IMMATURE LIMNEPHILIDAE (9560)                        1 - 3       0.      0.      5.                                   5.
    DIPTERA
        CHIRONOMIDAE, TRIBE TANYTARSINI
            PARATANYTARSUS SP. (13790)                           1 - 3       2.      5.      0.                                   7.
        CHIRONOMIDAE, S-FAM ORTHOCLADIINAE
            CORYNONEURA SP (14415)                               1 - 3       1.      0.      0.                                   1.
            SYNORTHOCLADIUS SP. (16010)                          1 - 3       2.      0.      1.                                   3.
    HYDRACARINA
            HYDRACARINA (ALL) (21400)                            1 - 3       0.      0.      1.                                   1.
        LEBERTIIDAE
            LEBERTIA SP. (21410)                                 1 - 3       0.      0.      4.                                   4.
    CLADOCERA
        DAPHNIIDAE
            DAPHNIA PULEX (31790)                                1 - 3       0.      2.      0.                                   2.
    COPEPODA
        CALANOIDA
            DIAPTOMUS ARAPAHOENSIS (37060)                       1 - 3       8.      6.      10.                                 24.
        CYCLOPOIDA
            CYCLOPOID COPEPODID (38010)                          1 - 3       0.      1.      1.                                   2.
    NEMATODA
            NEMATODA - ALL (50610)                               1 - 3       2.      2.      1.                                   5.
    OLIGOCHAETA
        NAIDIDAE
            NAIDIDAE - ALL (59020)                               1 - 3       1.      0.      0.                                   1.

                TOTAL FOR  11 SPECIES BY REPLICATE:              1 - 3       16.     16.     23.

                TOTAL FOR   3 REPLICATES,  11 SPECIES:                       55.
```

APPENDIX I. RAW QUALITATIVE INVERTEBRATE SAMPLE DATA FROM NED WILSON SPRING, AUGUST 18, 1982.

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                                                                                                   PAGE  1
PROJECT:  ACID RAIN PROJECT (AR)                      AREA:  RED WILSON LAKE (23)
STATION:  SPRING, 100M N RED WILSON LAKE                                                    DATE:  AUGUST 18, 1982
SAMPLER TYPE:  QUALITATIVE DIP NET SAMPLE (40)                                               SUBSTATION:    8
NUMBER OF REPLICATES:    1      FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)


                                                      RAW DATA TABLES

  1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE
            GENUS/SPECIES                                          REPLICATES           COUNTS                    TOTAL FOR SP.

  TRICHOPTERA
       LIMNEPHILIDAE
            LIMNEPHILUS EXTERNUS (9563)                             1 - 1       27.                                      27.
            LIMNEPHILUS SP. (9567)                                  1 - 1        1.                                       1.
            PSYCHORONIA COSTALIS (9610)                             1 - 1        1.                                       1.
  DIPTERA
       CHIRONOMIDAE, TRIBE CHIRONOMINI
            CRYPTOCHIRONOMUS SP. (12390)                            1 - 1        1.                                       1.
            DICROTENDIPES SP. (12410)                               1 - 1        1.                                       1.
            GLYPTOTENDIPES SP. (12500)                              1 - 1        1.                                       1.
            PHAENOPSECTRA SP. (13360)                               1 - 1       19.                                      19.
       CHIRONOMIDAE, TRIBE TANYTARSINI
            TANYTARSUS SP. (13700)                                  1 - 1        2.                                       2.
       CHIRONOMIDAE, S-FAM ORTHOCLADIINAE
            CORYNONEURA SP (14415)                                  1 - 1       31.                                      31.
            CRICOTOPUS LARICOMALIS (14560)                          1 - 1        1.                                       1.
            THIENEMANNIELLA SP. (16000)                             1 - 1        1.                                       1.
  LEPIDOPTERA

            LEPIDOPTERA - ALL (19500)                               1 - 1        2.                                       2.
  HYDRACARINA
       LEBERTIIDAE
            LEBERTIA SP. (21410)                                    1 - 1        3.                                       3.
  OSTRACODA
       CYPRIDAE
            CANDONA SCOPULOSA (33600)                               1 - 1       44.                                      44.
  AMPHIPODA
       TALITRIDAE
            HYALELLA AZTECA (41060)                                 1 - 1       14.                                      14.
       GAMMARIDAE
            GAMMARUS LACUSTRIS (41326)                              1 - 1      105.                                     105.
  NEMATODA

            NEMATODA - ALL (50610)                                  1 - 1        3.                                       3.
  OLIGOCHAETA
       NAIDIDAE
            NAIS SPP. (59021)                                       1 - 1        5.                                       5.
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                                                                                                                PAGE  2

PROJECT:  ACID RAIN PROJECT (AR)                       AREA:  NED WILSON LAKE (23)                        DATE:  AUGUST 10, 1982
STATION:  SPRING, 100M N NED WILSON LAKE                                                                   SUBSTATION:    8
SAMPLER TYPE:  QUALITATIVE DIP NET SAMPLE (40)
NUMBER OF REPLICATES:   1     FIELD BIOLOGIST:  WES KINNEY (5)
NOTE:  NOT APPLICABLE (0)

                                                      RAW DATA TABLES

  1ST LEVEL REFERENCE
       2ND LEVEL REFERENCE                                        REPLICATES            COUNTS                        TOTAL FOR SP.
            GENUS/SPECIES

  OLIGOCHAETA
       TUBIFICIDAE
            IMMATURE TUBIFICIDAE - W.O.C.C. (60000)               1 - 1      37.                                          37.
            LIMNODRILUS HOFFMEISTERI (SPIRALIS FORM) (60020)      1 - 1       1.                                           1.
  HIRUDINEA
       ERPOBDELLIDAE
            NEPHELOPSIS OBSCURA (62532)                           1 - 1       3.                                           3.
  PELECYPODA
       SPHAERIIDAE
            PISIDIUM SP. (65035)                                  1 - 1     128.                                         128.


                 TOTAL FOR  22 SPECIES BY REPLICATE:              1 - 1     501.

                 TOTAL FOR   1 REPLICATES,  22 SPECIES:                     501.
```

APPENDIX J. DIGESTED TISSUE DATA FROM NED WILSON LAKE (*S. fontinalis*) AND UPPER ISLAND LAKE (*S. clarki*) FISH COLLECTED DURING 1982 and 1983.

Lake/Date	Sample	Element (mg/kg)														
		As	Se	Fe	Mn	Pb	Be	Cd	Cr	Zn	Ni	Cu	Ag	Al	Hg	Mg
Ned Wilson 07-06-82	S. fontinalis Whole No. 1	<0.08	3.4	N/A	N/A	1.2	(<1.2)	1.2	2.3	75	0.2	4.6	<0.001	N/A	N/A	N/A
	S. fontinalis Whole No. 2	<0.08	3.6	N/A	N/A	2.4	0.3	1.2	0.6	157	2.0	5.0	<0.001	N/A	N/A	N/A
	S. fontinalis Whole No. 3	<0.08	3.3	N/A	N/A	1.0	0.5	0.6	3.5	96	1.9	4.9	<0.001	N/A	N/A	N/A
	S. fontinalis Whole No. 4	<0.08	3.1	N/A	N/A	1.5	0.4	1.0	3.3	128	5.5	5.2	<0.001	N/A	N/A	N/A
	S. fontinalis Whole No. 5	<0.08	3.3	N/A	N/A	1.2	<0.15	0.7	3.4	105	1.0	5.7	<0.001	N/A	N/A	N/A
	S. fontinalis Whole No. 6	<0.08	2.9	N/A	N/A	1.3	<0.15	0.7	3.2	135	0.9	5.0	<0.001	N/A	N/A	N/A
Ned Wilson 08-25-83	S. fontinalis Whole No. 1	<0.05	0.8	<5	<2.5	45	N/A	0.7	4	173	93	141	<2.5	85	<38	<25
	S. fontinalis Whole No. 2	<0.05	0.8	<5	<2.5	44	N/A	0.7	3	174	96	143	<2.5	80	<38	<25
	S. fontinalis Gills No. 2	<0.05	0.08	<5	<2.5	19	N/A	2.7	<3	102	<8	6	<2.5	388	N/A	<25
Upper Island 08-27-83	S. clarki Whole No. 1	<0.05	0.2	<5	<2.5	86	N/A	0.6	3	965	(1164)	1060	<2.5	<50	<38	<25
	S. clarki Whole No. 2	<0.05	0.4	<5	<2.5	92	N/A	0.6	4	991	(1199)	1090	<2.5	<50	<38	<25
	S. clarki Gills No. 3	<0.05	1.6	<5	<2.5	3	N/A	0.8	<3	65	<3	11	<2.5	<50	N/A	<25

APPENDIX K. DIGESTED SEDIMENT METAL CONCENTRATIONS FROM COLORADO FLAT TOPS LAKES, 1982 and 1983 SURVEYS. Concentrations are mg/kg, except Al (g/kg).

Lake	Site	Repli-cate	Element (mg/kg)													
			Date	Al[1]	Cd	Zn	Cn	Cr	Pb	Se	As	Ni	Fe	Mn	Mg	As
Ned Wilson	NW2	1	8/25/83	24, 21	0.352	84	22	42	25	<0.025	0.015	33	<5	<2.5	<25	<2.5
		2		28, 24	0.385	68	16	45	29	<0.025	0.017	37	<5	<2.5	<25	<2.5
		3		27, 23	0.379	74	21	60	22	<0.025	0.017	43	<5	<2.5	<25	<2.5
Oyster	OL2	1	8/18/82	18, 18	0.555	59	19	34	37	<0.025	0.009	22	<5	<2.5	<25	<2.5
		2		18, 17	0.347	53	15	36	27	<0.025	0.009	21	<5	<2.5	<25	<2.5
Upper Island	UI4	1	8/27/83	37, 31	0.180	73	20	30	20	<0.025	0.026	30	<5	<2.5	<25	5
		2		25, 22	0.120	83	(1216)[2]	26	36	<0.025	0.013	24	<5	<2.5	<25	<2.5
		3		36, 30	0.225	104	(925)[2]	36	50	<0.025	0.022	30	<5	<2.5	<25	<2.5

Note 1. Second verification run conducted, concentration of Al is g/kg.
Note 2. Parentheses identify outliers not included in mean estimates.

APPENDIX L. WATER CHEMISTRY DATA FROM COMPOSITE SAMPLES TAKEN AT COLORADO FLAT TOPS LAKES, AUGUST 1983. Concentrations are µg/l unless otherwise noted.

Lake	Site	Rep.	Cl	SO_4	NO_3	NO_2	F	NH_4	Alk (ueq/l)	Color (NTU)	Total P	TOC (mg/l)	DOC (mg/l)	uncorr chl a	corr chl a
Ned Wilson	**NW1**	1	126	484	<164	<7.2	<60	30	84	0	16	2.7	4.4	1.232	-2.937
		2	153	503	<164	<7.2	<60				15	1.7	1.1	1.232	-2.937
		3	122	502	<164	<7.2	<60				16	6.4	1.9	1.219	-2.483
	NW2	1	140	482	<164	<7.2	<60	25	88	0	16	1.8	4.0	1.348	-2.296
		2	141	458	<164	<7.2	<60				16	2.0	1.9	1.334	-2.296
		3	150	535	<164	<7.2	<60				16	2.5	1.4	1.232	-2.029
	NW3	1	117	584	<164	<7.2	<60	33	78	0	16	3.6	1.3	1.232	-1.575
		2	128	546	<164	<7.2	<60				16	2.3	2.5	1.116	-1.762
		3	118	523	<164	<7.2	<60				16	2.5	5.4	1.232	-2.029
	NW4	1	93	528	<164	<7.2	<60	30	62	0	16	1.8	3.8	1.450	-2.563
		2	100	568	<164	<7.2	<60				16	2.0	3.0	1.383	-1.842
		3	98	560	<164	<7.2	<60				16	2.0	3.6	1.232	-2.029
Oyster	**OL1**	1	174	735	<164	<7.2	<60	51	210	0	18	4.9	<0.2	1.113	-0.249
		2	204	764	<164	<7.2	<60				18	5.5	<0.2	1.045	0.187
		3	152	764	<164	<7.2	<60				18	4.7	<0.2	1.437	-0.294
	OL2	1	178	761	<164	<7.2	<60	42	222	0	19	6.5	0.9	1.205	0.240
		2	182	854	<164	<7.2	<60				18	4.5	<0.2	1.321	0.427
		3	182	784	<164	<7.2	<60				18	4.3	<0.2	1.234	-0.214
Upper Island	**UI1**	1	72	551	<164	<7.2	<60	36	96	0	12	2.6	1.4	0.857	0.587
		2	92	565	<164	<7.2	<60				12	2.6	3.2	0.973	0.320
		3	107	559	<164	<7.2	<60				11	2.1	0.5	0.960	0.774
	UI2	1	168	526	<164	<7.2	<60	22	92	0	14	3.4	<0.2	0.973	0.320
		2	192	538	<164	<7.2	<60				14	3.1	<0.2	0.974	0.774
		3	198	532	<164	<7.2	<60				14	3.1	0.5	1.090	1.869
	UI3	1	122	521	<164	<7.2	<60	12	96	0	14	1.1	<0.2	1.482	-0.107
		2	189	532	<164	<7.2	<60				14	1.2	<0.2	1.279	0.427
		3	200	532	<164	<7.2	<60				15	2.9	<0.2	1.279	0.427
	UI4	1	122	624	<164	<7.2	<60	48	100	0	14	2.4	<0.2	0.989	0.774
		2	106	619	<164	<7.2	<60				14	1.2	<0.2	0.974	0.774
		3	102	616	<164	<7.2	<60				14	2.2	<1.0	1.076	0.507

APPENDIX M. WATER CHEMISTRY DATA FROM DEPTH PROFILES TAKEN AT NED WILSON LAKE, OYSTER LAKE, AND UPPER ISLAND LAKE, COLORADO FLAT TOPS, AUGUST 1983.

Ned Wilson Lake

Time/Site	Depth (m)	Temp. (°C)	D.O. (mg/ℓ)	COND. (μmho/cm)	pH
NW1 0830 Hrs.	0	15.6, 15.7	6.4, 6.0	70, 70	7.3, 6.9
	1	15.6, 15.7	6.2, 6.2	80, 80	7.2, 7.0
	2	15.6, 15.6	6.6, 6.5	90, 70	7.2, 7.0
	3	15.6, 15.6	6.6, 6.5	70, 70	7.1, 7.0
	4	15.6 -	6.8 -	80 -	7.0 -
	5	15.6, 15.6	6.8, 6.9	70, 70	7.1, 6.9
NW2 1015 Hrs.	0	15.9, 15.8	6.3, 6.2	60, 60	6.8, 6.8
	1	15.9, 15.8	6.0, 5.9	60, 60	6.8, 6.8
	2	15.9, 15.8	6.0, 5.9	60, 60	6.8, 6.8
	3	15.9, 15.8	6.2, 6.0	60, 60	6.8, 6.8
	4	15.8, 15.8	6.0, 6.0	60, 60	6.8, 6.8
	5	15.8, 15.8	6.1, 6.0	60, 60	6.8, 6.8
NW3 1230 Hrs.	0	16.7, 16.4	5.9, 6.3	60, 60	6.8, 6.8
	1	16.3, 16.1	5.9, 6.6	60, 60	6.9, 6.8
	2	16.2, 16.1	5.9, 6.5	60, 60	6.9, 6.8
	2.5	16.1, 16.1	5.8, 5.8	60, 60	6.9, 6.9
NW4 1500 Hrs.	0	16.9, 16.8	5.7, 5.8	60, 60	6.4, 6.4
	1	16.8, 16.5	5.6, 5.8	60, 60	6.4, 6.5
	2	16.5, 16.3	6.0, 5.7	60, 60	6.4, 6.5
	3	16.4, 16.2	6.0, 5.8	60, 60	6.4, 6.5
	4	16.2, 16.2	6.1, 6.0	60, 60	6.4, 6.5
	5	16.2, 16.2	6.3, 6.2	60, 60	6.5, 6.5

Oyster Lake

Site/Time	Depth (m)	Temp. (°C)	D.O. (mg/ℓ)	COND. (μmho/cm)	pH
OL1 1715 Hrs.	0	19.1	6.4	110	8.3
	1	18.9	6.1	110	8.2
	2	18.4	6.2	120	8.2
	3	18.3	6.2	120	8.2
OL2 0930 Hrs.	0	18.2	6.0	110	8.1
	1	18.3	6.2	110	8.2
	2	18.3	6.2	110	8.2
	3	18.3	6.2	110	8.2

Upper Island Lake

Site/Time	Depth (m)	Temp. (°C)	D.O. (mg/ℓ)	COND. (µmho/cm)	pH
UI1 1100 Hrs.	0	14.8, 14.7[1]	7.1, 7.4	70, 70	5.8, 6.2
	1	14.8, 14.5	7.6, 7.3	70, 70	6.0, 6.2
	2	14.6, 14.4	8.0, 7.3	70, 70	6.1, 6.2
	3	14.3, 14.2	8.4, 8.5	80, 70	6.1, 6.2
	C[2]				6.2[3]
UI2 1230 Hrs.	0	14.6, 14.5	7.7, 7.4	70, 70	6.4, 6.5
	1	14.6, 14.5	7.8, 7.6	70, 70	6.4, 6.5
	2	14.4, 14.2	7.9, 7.9	70, 70	6.4, 6.5
	3	14.3, 14.2	8.1, 7.7	70, 70	6.5, 6.5
	3.5	14.2, 14.2	7.9, 7.7	70, 70	6.5, 6.5
UI3 1440 Hrs.	0	14.5	7.7	70	6.5
	1	14.5	7.7	70	6.5
	2	14.5	7.8	70	6.5
	3	14.4	7.8	70	6.5
	4	14.2, 14.2	7.8, 7.6	70, 70	6.5, 6.6
	5	14.2	7.8	70	6.6
	6	14.1	7.8	70	6.6
	6.5	14.1	7.8	70	6.6

Note 1. Duplicate readings usually signify both downward and retrieval measurements.

Note 2. C designate a composite sample 1 meter below surface and 1 meter above bottom.

Note 3. Beckman portable pH meter reading.

Note 4. Secchi depth 9.5 m.

Upper Island Lake

Site/Time	Depth (m)	Temp. (°C)	D.O. (mg/ℓ)	COND. (μmho/cm)	pH
UI4 1700 Hrs.	0	14.8	6.0	7.0	6.3
	1	14.8, 14.4	6.0, 7.6	60, 60	6.3, 6.3
	2	14.8	6.0	70	6.4
	3	14.7	6.0	70	6.4
	4	14.6	6.1	70	6.5
	5	14.4, 13.2	6.1, 8.6	70, 60	6.6
	7	14.4	7.8	70	6.7, 6.2
	7	13.2	8.4	60	7.2
	8	11.5	8.5	70	7.3
	9[4]	8.5	9.5	60	7.2
	10	8.0, 7.1	9.7, 7.7	70, 70	7.1, 5.9
	11	7.0	9.6	70	6.8
	12	6.5	9.0	70	6.7
	13	6.3	8.8	70	6.7
	14	6.2, 6.0	7.8, 4.8	70, 80	6.4, 5.9
	15	6.0, 6.1	5.6, 4.8	80, 80	6.3, 6.0
	16	6.0	4.8	80	6.1

APPENDIX N. TOTAL METAL CONCENTRATIONS FROM FLAT TOPS LAKES SAMPLES COLLECTED AUGUST 1983. Aberrant data is suggested by values in parentheses. Less than signs indicate values below detection limits.

Lake	Site	Replicate	Element (µg/L)													
			Al[1]	Cd	Zn	Cu	Cr	Pb	Se	As	Ca	Ni	Fe	Mn	Mg	As
Ned Wilson	1	1	<90	0.3	64	5	<50	7	<0.5	<1	1429	<50	<100	<50	<500	<50
		2	<90	0.2	39	12	<50	5	<0.5	<1	1243	<50	<100	<50	<500	<50
		3	<90	-	42	6	<50	-	<0.5	<1	1557	<50	<100	<50	<500	<50
	2	1	99	0.3	44	8	<50	5	<0.5	1	1171	<50	165	<50	<500	<50
		2	123	1.1	81	15	<50	15	<0.5	<1	2478	<50	<100	<50	<500	<50
		3	<90	0.3	52	11	<50	6	<0.5	<1	1267	<50	<100	<50	<500	<50
	3	1	<90	0.4	53	15	<50	6	<0.5	<1	1556	<50	<100	<50	<500	<50
		2	153	0.4	78	13	<50	8	<0.5	<1	1444	<50	<100	<50	<500	<50
		3	110	0.3	68	11	<50	5	<0.5	<1	1233	<50	<100	<50	<500	<50
	4	1	107	0.2	44	5	<50	4	<0.5	<1	1122	<50	<100	<50	<500	<50
		2	93	0.3	54	11	<50	(27)	<0.5	<1	1211	<50	<100	<50	<500	<50
		3	<90	0.3	45	9	<50	4	<0.5	1	1100	<50	<100	<50	<500	<50
Oyster Lake	1	1	95	0.3	69	13	<50	11	<0.5	<1	2700	<50	108	<50	1023	<50
		2	113	1.3	105	20	<50	12	<0.5	<1	2700	<50	112	<50	1042	<50
		3	101	0.2	52	8	<50	6	<0.5	<1	2600	<50	<100	<50	1038	<50
	2	1	<90	0.2	50	13	<50	6	<0.5	1	2600	<50	<100	<50	541	<50
		2	137	0.3	61	17	<50	8	<0.5	<1	2700	<50	<100	<50	981	<50
		3	104	-	(152)	(59)	(95)	-	(14)	(16)	2700	53	<100	<50	1052	<50
Upper Island	1	1	94	0.4	38	15	<50	4	<0.5	2	1400	<50	<100	<50	<500	<50
		2	<90	0.3	45	10	<50	5	<0.5	2	1500	<50	<100	<50	<500	<50
		3	124	0.5	62	16	<50	7	<0.5	2	1700	<50	<100	<50	<500	<50
	2	1	<90	0.2	53	7	<50	4	<0.5	<1	1400	<50	<100	<50	<500	<50
		2	113	0.2	54	7	<50	4	<0.5	<1	1400	<50	<100	<50	<500	<50
		3	<90	(20)	(158)	(64)	<50	(81)	(17)	(21)	1300	108	<100	<50	<500	<50
	3	1	<90	0.2	47	<5	<50	5	<0.5	<1	1700	<50	<100	<50	<500	<50
		2	<90	0.2	51	8	<50	5	<0.5	<1	1500	<50	<100	<50	<500	<50
		3	<90	0.2	55	7	<50	3	<0.5	<1	1600	<50	<100	<50	<500	<50
	4	1	168	0.4	65	14	<50	9	<0.5	<1	1900	<50	282	<50	<500	<50
		2	96	0.3	49	14	<50	7	<0.5	<1	1600	<50	<100	<50	<500	<50
		3	<90	0.3	49	25	<50	6	<0.5	<1	1300	<50	<100	<50	<500	<50